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The Progress of Electrical Science. IN another column we give the admirable address of Professor Brackett at the centennial of the patent system. It would have been hard to summarize more neatly the effect of invention on the development of electrical science. It is no easy matter to skim through a century and point out the growth of such a vast subject. American genius has played so important a part in applied electricity that Professor Brackett's remarks were especially pertinent to the occasion which called them forth. In particular it is well worth having attention called to the labors of that tireless pioneer in electricity, Joseph Henry, whose lifelong labors are just now beginning to be properly appreciated.

A Successful Celebration. THE centenary of the American Patent System, held in Washington last week, was of remarkable interest and value. It gathered together inventors, manufacturers and scientific men from all parts of the country and representing every interest. The meetings were largely attended and the addresses were of a high order of merit. Perhaps the most important business transacted was the formation of the American Association of Inventors and Manufacturers, organized on a broad and liberal basis to include every one immediately interested in the commercial relations of the Patent Office. It was designed in this way to bring together on the common ground of friendly intercourse those elements in the community that can most successfully work for their mutual good and the public progress. Electricians may feel well pleased at their position and representation in this important organization. Two members of the electrical fraternity are in the board of directors of the new association, and two of the vice-presidents are Gardiner G. Hubbard, of telephone fame, and Prof. William A. Anthony, president of the American Institute of Electrical Engineers. No higher compliment or more complete recognition of the importance of the electrical industries could have been made than the selection of these gentlemen. Success to the American Association of Inventors and Manufacturers, and may it make its influence felt on American inventive genius!

Another Subway Scheme. No more iniquitous job has showed its head in public for many a day than the bill that passed the New York Legislature last week. Months since, when the proposition to give up part of the work of the Subway Company to the Empire City Subway Company was made, we called attention to the disastrous effect that such a move would have on the future electrical development of New York City. Though action at that time was stopped by legal measures, the bill that was railroaded through the Assembly authorizes precisely the outrage on the public that had been proclaimed illegal. The purpose of the bill nominally is to facilitate the construction of subways by removing part of the burden that has rested on that dilatory enemy of the public weal, the Subway Company. Its real effect will be to give the electrical subways of New York City bodily into the hands of the Western Union Telegraph Company and its amiable confrere the Metropolitan Telegraph & Telephone Company. If the bill becomes a law, and its provisions are carried out, it will make the establishment of a competing telephone service, after the expiration of the Bell patents, practically impossible, besides enabling electric lighting and power companies that operate low tension circuits substantially to prohibit competition; for since the bill permits the transfer of subways from the old to the new company it will be no difficult matter to avert the construction of high tension conduits. The history of the subway in New York has uniformly been marked by reckless disregard of the rights of the public, but this last move caps the climax. If there ever has been passed a bill more thoroughly inimical to the progress of the city and the rights of the citizens, we have yet to learn of it.

Long Distance Transmission of Power. A BRIEF article elsewhere in our pages gives additional information concerning the splendid project for transmitting power over a hundred miles to the coming exhibition at Frankfort-on-the-Main. We have followed the progress of these experiments from the beginning, and have already published several notes on the subject. The present one, however, gives more details than have heretofore appeared. As we have before remarked in these pages, the plan is entirely practicable, and if tried can hardly fail of success. The alternating system, with its marvelous facilities for the transmission of electrical energy from one voltage to another, is peculiarly well adapted to such work. In fact, the difficulties of attempting anything of the kind with direct currents are so forbidding as to almost prohibit the effort. But this experiment that will be tried the coming summer opens up a possibility that may well be taken into consideration by the authorities of the Columbian Exposition. Unless unforeseen difficulties are encountered on the line from Lauffen to Frankfort, why should not our own enterprising engineers undertake the transmission of power from Niagara Falls to Chicago in 1893? The distance is a trifle over 500 miles, rather more than four times that to be tried on the other side of the water; this, of course, means—other things being equal—four times the loss of potential, four times the losses from leakage and other sources. But at such extremely long range high efficiency is not to be expected, and losses far greater than those to be met at Frankfort could well be permitted in such a task. In fact, with 30,000 volts pressure, the efficiency of transmission could be brought up to 50 or 60 per cent. without using so large a conductor as to raise the cost of installation to any fabulous figure. No one would expect great economy under the circumstances, but it would be such a lesson in the transmission of electrical power to distant points as the world would not soon forget. The Columbian Exposition will come at a time of the year suitable for such work; our hot and comparatively dry summers enable insulation to be kept up to a point hard to reach in England, or in any continental country. Further, these are the days when every electrical engineer feels the necessity of pushing electrical power transmission to the front as the most available and desirable means for opening up to industrial use sections of our country where the cost of fuel is almost prohibitive. It is more than probable that, in case it were desirable to undertake such a feat as operating motors in Chicago from dynamos at Niagara Falls, machinery for the installation would be gladly furnished by the enterprise and public spirit of some one of the large electrical companies that desire to make a specialty of long-distance work, and possibly a combination of interests might even put through the whole enterprise, gigantic as it is, for the splendid prestige that success would bring. At all events, the possibility of such an engineering feat is worth talking about and thinking about. Perhaps, on investigation, it would be found impracticable to meet the cost of construction but there is certainly more than a possibility that the dash and vigor that have characterized American engineering operations and American electrical companies will not let slip an opportunity so magnificent as that we have mentioned. A tower is being planned for the Columbian Exposition to out-Eiffel Eiffel; why not electric transmission of power on a scale to put quite into the background anything previously attempted?

The History of Electricity and Magnetism. ON another page we give the opening section of a series of papers that, we feel sure, will meet a need that is often felt by students of electricity. Mr. Mottelay's research has been an exceedingly painstaking and careful one, and will be found particularly rich in information concerning periods generally almost completely neglected by those who speak of the history of electricity. It covers, as will be seen, three distinct epochs, bringing the subject from the earliest recorded date at which any use was made of electric and magnetic phenomena up to the midst of the busiest period of electrical development during the latter half of the last decade. Part I. embraces everything of note up to and including the year 1800, when Volta announced in a letter to Sir Joseph Banks his great discovery of the galvanic current. As is well known, the publication of this letter in the *Philosophical Transactions* was immediately followed by the brilliant investigations of Nicholson and Carlisle, of Berzelius and Hisinger, of Dr. William Henry and of Sir Humphrey Davy, which established a new epoch in the history of chemistry. Part II., A. D. 1800 to 1820, covers the period of the general employment for telegraphic purposes of voltaic or galvanic, in lieu of static or frictional electricity, up to the time of the announcement, through Thomson's *Annals*, of Oersted's discovery, which laid the foundation of the science of electromagnetism. From the year 1820 likewise date, more particularly, Ampère's exposition of the phenomena of electro-dynamics, as well as the important experiments in that line made by Arago and Davy, whose united work was afterward so assiduously and effectively followed by the eminent experimental philosopher, Michael Faraday. Part III. extends from A. D. 1820 to 1844, when Leon Foucault constructed the first practical arc light, anticipating by one year King's successful application of the incandescent mode of electric lighting, while Part IV., A. D. 1844 to 1888, embodies the very important discoveries and applications made in all of the above-named lines up to the date last mentioned. It will be seen that the careful compiler has, throughout, confined himself to facts associated exclusively with the above-named branches, embracing likewise all forms of the optical telegraph. Chronological reference to many of the ancient and historical means of communicating intelligence rapidly at great distances has been thought advisable, and will doubtless, to most of our readers, prove no less interesting than all the rest of the data thus, for the first time, carefully epitomized and intelligently brought together. To avoid discussions, and in order to set at rest all possible argumentative inquiry as to the merits of discoveries, relative to which conflicting authorites exist, it has been deemed best to quote all of the most important inventions, etc., under their respective heads and dates. To the would-be historian and delving student this will certainly appear the better course, if they but take, as a case in point, the invention of the compass, as well as its original use in navigation, claimed alike for China, Iceland, France, England and Italy by equally eminent writers and scientists. As very nearly all but the earliest important discoveries have already been traced to their respective sources by many authors, additional historical facts have been quoted whereever such announcements seemed deserving of more than the ordinary notices previously accorded them in print, or where the nature of the discovery or identity of its maker merited authentication beyond the possibility of all further doubt. It is needless to say that, notwithstanding the very great care already given to the preparation, and which will likewise hereafter attend the regular publication of this "Chronological History," errors may present themselves. Such mistakes as prove of a typographical nature can, of course, be easily remedied; the correction of the others, which must needs result from the conflict of authorities, will most speedily be made if, as we trust, our attention is duly called thereto by appreciative readers, to whom we shall in all cases gladly give proper credit.

Latest Foreign Electrical News.

(By Cable from our Regular Correspondent.)

London, April 13, 1891.—Mr. Esson's paper on "The Design of Multipolar Dynamos," read before the Institution of Electrical Engineers on last Thursday, treated the subject with great thoroughness, but the discussion was unfortunately disappointing. The speakers were Silvanus P. Thompson and Mr. Anderson.

Sir William Thomson's paper on "Electrostatic and Electromagnetic Screening," was read before the Royal Society on Thursday and before the Royal Institution on Friday, and proved to be most interesting, as might have been expected.

Mr. J. J. Carty's paper on "Inductive Disturbances in Telephone Circuits," read before the American Institute of Electrical Engineers, and published in The Electrical World of March 28, has created a vigorous discussion, and the correctness of his theory is doubted by numerous electricians.

Besides the demonstrations made at the opening of the London-Paris telephone line a further exhibition of the capabilities of the line was recently given by the transmission of music from the Paris Opera to the London terminus of the line. This test was very successful in every way, and admirably showed the delicate adjustment of the line.

The Thomson-Houston Electric Company, of Boston, Mass., has made a bid for the electric lighting of the city of Glasgow, Scotland. That city owns its own gas works, and as a result its progress in electric lighting is very slow.

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Chronological History of Electricity, Galvanism, Magnetism and the Telegraph, from B. C. 2637 to A. D. 1888.—Part I.

BY P. F. MOTTELAY.

Electricity, *elektron, electrum*, meaning amber, from *helko*, to draw, in reference to its property of attracting light bodies.

Galvanism, from the name of its discoverer, Aloysio Galvani, an Italian physician—Bologna, 1737-1798.

Magnetism, *magnes*, the natural magnet loadstone or lodestone found abundantly near Magnesia, in Lydia. It is said that Magnes, a Greek shepherd, observed the attractive power of the loadstone on his metallic crook, and that the Greeks obtained the stone from Magnesia as early as 1000 B. C. The savant, Mr. Sonnini, says in his notes upon Buffon, Article II., that many believe the word *magnes* to have come from *magnitudo*, and to have been applied to the magnet owing to its grand properties.

Telegraph (*tele*, afar off; *graphein*, to write), an apparatus for communicating intelligence rapidly at great distances.

B. C. 2637.——This is the earliest known date at which anything resembling the application of the magnetic influence is alluded to in history. It is related that in this, the sixty-first year of the reign of Hoang-ti (Yeou-hioung-ché, also named Koung-fun and Hiuen-yuen), the emperor's troops, who were pursuing the rebellious prince Tchéyeou (Tchi-yeou), lost their way, as well as the course of the wind, and likewise sight of their enemy, during the heavy fogs prevailing in the plains of Tchou-lou. Seeing which, Hoang-ti constructed a chariot upon which stood erect a prominent female figure which indicated the four cardinal points, and which always turned to the south whatever might be the direction taken by the chariot. By that means he succeeded (B. C. 2634, Klaproth, "Boussole," p. 74) in capturing the prince, whom he put to death. (Du Halde, "Description de la Chine, etc.;" La Haye, 1736, vol. I., p. 270.)

Some say that upon this chariot " . . . stood a needle to denote the four parts of the world. That would indicate the use of the compass, or something very similar to it, . . . and it is unfortunate the device has not been explained more fully . . ." (Du Halde, I., 271.)

Hoang-ti (Hoang, supreme king), regarded as the founder of the Chinese Empire, died at the age of 121, after reigning 100 years, B. C. 2598. Mailla (Joseph A. M. de Moynac de), in his "Histoire . . . traduite du Tong-Kien-Kang-Mou," Paris, 1777, vol. I., p. 28, makes the latter date 2599. See Azuni, "Boussole," Paris, 1809, pp. 186, 214; Staunton's "China," London, 1797, vol. I., p. 446; "Ency. Metrop.," vol. 3, p. 736; Buffon, "La Terre," vol. I., p. 304; Davis, "The Chinese," 1844, vol. III., p. 14; Humboldt, "Cosmos," 1848, vol. V., p. 511, for Ed. Biot in *Comptes Rendus*, T. XIX., 1844, p. 822; Klaproth, "Boussole," pp. 33–34, 71, 76, 79, 82, and for their introduction in Japan, pp. 93 to 94.

B. C. 1110.——Tcheou-Koung is said to have at this date taught the use of the needle compass to the envoys from Youa-tchang. "As the ambassadors sent from Cochin China and Tonquin ("Cosmos," V., p. 51) were about to take their departure (which was in the twenty-second cycle, more than 1,040 years B. C.), Tcheou-Koung gave them an instrument which upon one side always turned toward the north, and on the opposite side to the south, the better to direct them upon their homeward voyage. This instrument was called *tchi-nan* (chariot of the south), and it is still the name given to the compass, which leads to the belief that Tcheou-Koung invented the latter." In his chapter on "The Magnetic Needle," Von Humboldt says the apparatus was called *fse-nan* (indicator of the south).

Tcheou-Koung (Ki-tan) was Chinese Minister of State under both Von-Vang (first emperor of the Tcheou dynasty, who ruled seven years) and Tching-Vang (second emperor, who ruled 37 years), and lived to be 100 years old. He was one of the most learned and most popular men China has ever known, and is spoken of to this day by the Chinese "with an admiration bordering upon enthusiasm." ("Mémoires Concernant l'Histoire," Saillant et Nyon, Paris, 1776, vol. III., p. 37.) The emperor Tching-Vang caused Tcheou-Koung's body to be interred near his father's remains, after giving it imperial funeral honors. See Du Halde, vol. I., p. 312; Klaproth, 81; Azuni, pp. 190, 191; "Cosmos," vol. II., p. 628.

B. C. 1084.——According to Æschylus, the father of the Athenian drama, Agamemnon employed a line of optical signals to advise his queen Clytemnestra of the fall of Troy. Robert Browning's translation, London, 1877, runs as follows:

" Troia the Achaioi hold . . .
Hephaistos—sending a bright blaze from Idé
Beacon did beacon send, from fire the poster,
Hitherward: Idé to the rock Hermaian
Of Lemnos: and a third great torch o' the island
Zeus' seat received in turn, the Athoan summit.
And—so upsoaring as to stride sea over,
The strong lamp-voyager, and all for joyance—
Did the gold-glorious splendor, any sun like,
Pass on. . . . "

Anna Swanwick thus renders Æschylus' "Agamemnon," London, 1881, p. 13:

" For Priam's city have the Argives won.

. . . . . .

Hephæstos sending forth Idaian fire.
Hither through swift relays of courier flame. . . ."

At page 193 of his "Agamemnon," London, 1873, E. H. Plumptre refers to the system of posts or messengers which the Persian kings seem to have been the first to organize, and which impressed the minds of both the Hebrews (Esth., viii., 14) and Greeks (Herod., VIII., 98) by their regular transmission of the king's edicts or of special news.

What of the passage from the celebrated patriarch Job (xxxviii., 35): "Canst thou send lightnings, that they may go, and say unto thee, Here we *are* (original Hebrew, "Behold us!")? As has been truly remarked, the above seems prophetic, when taken in connection with the electric telegraph.

The fire beacons are also alluded to by Plutarch in his "Life of Quintus Sertorius;" and Mardonius prepared fire signals to notify Xerxes, then at Sardis, of the second taking of Athens. See "Le Théâtre des Grecs," P. Brumoy, Paris, 1820, vol. II., pp. 124, 125; "Penny Cyclopædia," vol. XXIV., p. 145; Knight's "Mechanical Dictionary," vol. III., p. 2,092.

B. C. 1068.——In the obscure age of Codrus, the last king of Athens, at about the period of the return of the Heraclidæ (descendants of Hercules) to the Peloponnesus, the Chinese had magnetic carriages, upon which the movable arm of the figure of a man continually pointed to the south as a guide by which to find the way across the boundless grass plains of Tartary. See "Cosmos," I., p. 173, and V., p. 50; "Meurs de Reg. Athen," lib. III., cap. 2.

B. C. 1083 to 975. Solomon, King of Israel, son of King David and of Bathsheba, who "in the Jewish scriptures has the first place assigned him among the wise men of the East," is believed by many to have known the use of the compass. The Spanish Jesuit, Pineda, and Athanasius Kircher assert the same, and state that Solomon's subjects employed it in their navigations. Others, notably Fuller, "Miscel," IV., cap. 19, and Levinus Lemnius, "De Occul. nat. mir," lib. III., have even tried to prove that Solomon was the inventor of the compass, and that it was in his time used by the Syrians, Sidonians and Phœnicians, but the contrary has been shown by Henry Kippingius in his "Antiq. Rom. deexped. Mar.," lib. III., cap. 6, as well as by Bochart, the geographer, in his "Geo. Sacr.," lib. I., cap. 38. See Venanson, "Boussole," Naples, 1808, p. 34; Enfield, "History of Philosophy," London, 1819, vol. I., p. 40; Cavallo, "Magnetism," 1787, p. 48.

B. C. 1022.——At this period the Chinese magnetic cars held a floating needle, the motions of which were communicated to the figure of a spirit whose outstretched hand always indicated the south. An account of these cars is given in the "Szuki" (Shi-ki), or "Historical Memoirs of Szu-ma-thsian" (Szumatsien), which were written early in the second century B. C., and are justly considered the greatest of all Chinese historical works, containing, as they do, the history of China from the beginning of the Empire to the reign of Hiao-wou-ti, of the Han dynasty. See Johnson's "Cyclopedia," I., 929; Humboldt's "Cosmos," II., 1849, p. 628; and Klaproth, "Boussole," 1834, p. 79, for further allusion to a passage in the "Tong-Kien-Kang-Mou," already referred to under date B. C. 2637.

B. C. 1000–907.——Homer, the greatest of epic poets, called the father of Greek poetry, and who, according to Enfield ("History of Philosophy," vol. I., p. 133), flourished before any other poet whose writings are extant, relates that the loadstone was used by the Greeks to direct navigation at the time of the siege of Troy.

Sonnini tells us that as this period is about the same as that of the Chinese chronicles, it can scarcely be doubted that the knowledge of both the polarity of the needle and of the use of the compass for navigation date back 3,000 years. (Buffon, "Terre," Paris, An. VIII., p. 304.

This ill accords, however, with the views of others who have concluded, doubtless rightly, that the Greeks, Romans, Tuscans and Phœnicians were ignorant of the directive property of the magnet, from the fact that none of the writings of Homer, Theophrastus, Plato, Aristotle, Lucretius, and Pliny make allusion thereto. (Humboldt, "Cosmos," 1859, vol. V., p. 51; *Good Words*, 1874, p. 70.) See Brumoy, "Théâtre des Grecs," 1820, I., p. 55; "The Iliad," Pope's trans., 1738. I., pp. 14, 20; Shaffner, "Telegraph Manual," p. 19; also all the references under the A. D. 121 date.

The Relation of Insurance Companies to the Electrical Industries.

BY C. E. WOODS, E. E.

It seems strange that the electrical industries, in their several different forms, should have been obliged to adopt for their guidance to safety of both property and life the rules and regulations devised by an organization so entirely different in its purposes as is an insurance company; and still more strange is it that the electrical fraternity seems to accept them with perfect abandon, and to make no apparent effort (at least with any definite result) for their own interests. To be sure the several associations of the country have at their conventions discussed the subject pro and con., but as yet, either from lack of interest or a proper understanding and investigation of the question, without result of any particular moment, and in this article an effort will be made to show the actual conditions bearing upon this question, and to show that the insurance companies are not infallible, but more particularly to show that the electrical fraternity have disregarded and are neglecting a field of work which should belong wholly to them.

In the first place we must understand that the insurance companies have absolutely no interest in the electrical industries except as they come in direct contact with their business, namely, the insuring of buildings containing apparatus for the generation, distribution or consumption of an electric current. We must understand, also, that the insurance companies were forced to take the work on their own shoulders as a matter of self-preservation, because those to whom the work properly belonged seemed to have no idea of what was wanted. It must not be forgotten, however, that we owe much of our improvement directly to the insurance companies, and that they have done for us a great and good work, as far as they have gone. But their requirements have many weak points—they contain some "*musts*," but more "*shoulds*," and while they have been the means of causing better insulation and improved safety devices to be made, they have been weak in leaving it a matter of choice whether good or poor insulation, proper or improper safety devices, shall be used.

It must have occurred to the insurance people that after having compiled a set of rules and regulations it was necessary to enforce them. But enforcing them means something besides sending an inspector around who takes a casual glance at this and that, fills out a blank report and goes on his way, rejoicing to think what a light task he really has. These things cannot be judged by their intention but by their results, and up to the present time, while the insurance companies have done much good, the results are far from satisfactory. Insufficient capacity of wire is the chief danger, as that means hot wires, and yet I have seldom seen an inspector stop long enough to figure out the system of distribution in a building under inspection. His greatest demand is for better insulation, and yet he never tests it. The best insulated wire in the world may be so mutilated by inexperienced workmen as to be no better than the cheapest, if as good, when the cheapest is put up properly. Again they cry out against high tension current when it is probably true that a high tension current of low ampèrage is a much safer fire risk than a low-tension current of heavy ampèrage.

Again, their rules only pertain to such parts of the work as directly affect their own interests, namely, the wiring of buildings. There are absolutely no rules for outside work, and, as a result, outside work has not been perfected in proportion to inside work. Many more things of a similar nature might be enumerated, but these are probably enough. This brings us face to face with the striking fact that the workers in the electrical industries have done actually nothing in a field of work which, by all right and reason, should belong to them—the forming of a set of rules and requirements to guide the electrical engineer and the station operator and manager in their respective duties. They should, of course, comply with insurance requirements; but, in formulating them, members of the electrical fraternity should look to their own interests as well. These rules should be made in three different forms: one for electrical engineers, one for managers of electric plants, and one for operators of electric plants, and they should then become State laws. They should embody a rule compelling any person applying for either of the three positions to pass an examination before an appointed board before he can hold or obtain such a position.

Here is material for the National Electric Light Association to work on. It falls within the province of that association to protect the industries its members repre-

sent, to free their work from its danger, and especially to provide the necessary facilities by means of which any one desiring to do so may obtain such instruction as will enable him to fill intelligently the position he seeks. It must come to this eventually; and why cannot something be done in time to prevent so much trouble? The demand for labor in this work is fast outgrowing the ability to supply it. All the movement lacks is leadership, and someone who is in a position to do so should take it up at once and see if something cannot be done to improve this condition of things.

Just a word about the so-called danger of an electric current. That there is danger, there is no doubt, if proper provision is not made and the current is not properly handled by intelligent men. But when properly handled by intelligent men it is one of the safest sources of power we have to deal with. Here then is the point for consideration: What is the proper provision? It certainly is not in giving a man totally ignorant of the subject a set of rules which may be construed into half a dozen different meanings, and then accepting his work as correct simply because he had these rules. Not at all. The man should first be prepared, and then he should be given the rules if he can pass an examination showing that he understands these rules thoroughly. All danger will then have been checked, for past experiences show that poor workmanship has caused more danger than anything else, and the sooner a point of attack is made on this quarter the better for all concerned.

To sum up the whole matter then we need a code of rules and regulations that shall become State laws, compiled by some one else than a party doing it purely in self-preservation; compiled by men directly connected with the question in hand, namely, by members of the electrical fraternity themselves. We want good, safe, systematic work outside as well as inside, and rules and regulations for that part of the work as well as any other. Let me say again that some one who is in a position to do so should take the lead in this important matter so that something definite may be accomplished.

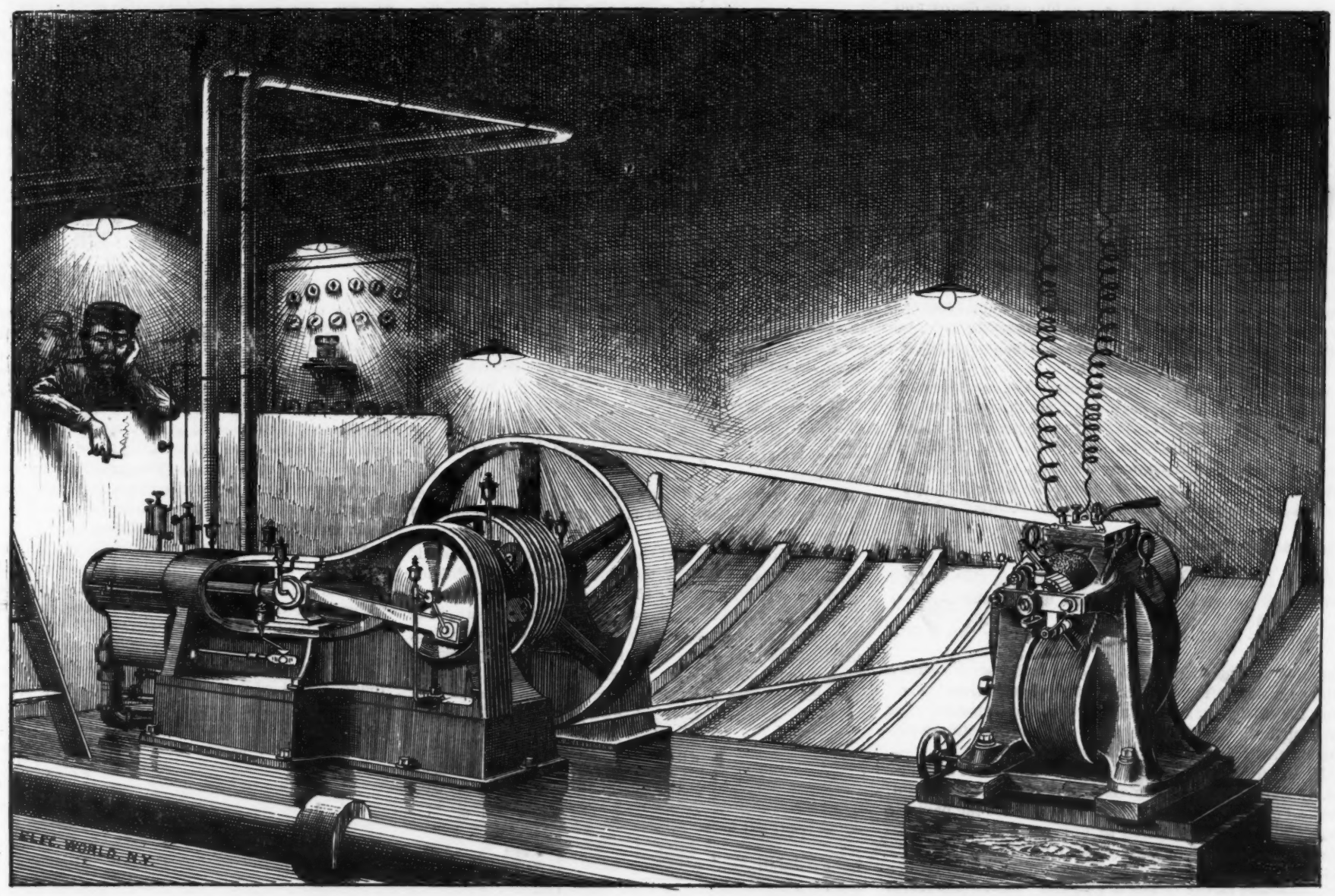
The London-Paris Telephone Line.

The capacity per mile of the land line in England is slightly higher than in France, since the Post Office grounds each pole. The 83 miles to Dover have a capacity of .015 of a microfarad per mile, the 204 miles in France have .012 of a microfarad per mile. The cable, which is 24 miles long, has a capacity of .23 of a microfarad per mile. The whole line is perfectly balanced, and the introduction of $\frac{1}{10}$ of a microfarad into either wire is enough to seriously interrupt communication. The four wires are maintained apart at the uniform distance of 14 inches. The line was recently put through to the Treasury, London, and it was found that speaking was quite impossible until the magnet of an indicator was cut out, when communication was found to be excellent. The call is made by 12 6-block agglomerate Leclanché cells. Only two of these are used for speaking.

Electric Light Plant on the Ferryboat John G. McCullough.

Few people even of those engaged in the electric lighting business are aware of the immense number of isolated lighting plants that are carried back and forth across the waters of the East and North rivers, to furnish illumination for the boats that ply between New York and the New Jersey and Long Island shores, or across the waters of New York Bay on the transatlantic passenger boats to foreign ports, and the merchant vessels running along the American coast. Typical plants of this character, as represented by the admirable installations on board the Majestic, the Puritan, the Pilgim, the Seguransa, and others, have been illustrated and described in former numbers of THE ELECTRICAL WORLD. This was one of the earliest branches of the electric lighting industry to receive attention at the hands of electrical engineers, and the special requirements of the service, such as the light weight and compactness of the plant, have brought out a large number of special designs for machines intended entirely for marine service. In many of these plants where space is an important consideration the plants are designed to be operated by an engine connected directly with the shaft of the dynamo, and this is especially true of the passenger boats that cross the Atlantic.

In the illustration on this page is shown a recent installation on one of the Erie ferryboats running between the foot of Chambers street, on the New York side, and Jersey City, N. J. The boat itself is of a new type, being a screw propeller, the main shaft running from end to end of the vessel between the two screws and being driven by vertical engines. The absence of the wheel houses projecting into the cabins makes it possible to construct the latter in a much more attractive shape. Both cabins extend the entire length of the boat, which is unusually long, and are highly decorated and ornamented with handsome trimmings. Each cabin is lighted by a central electrolier and two rows of side lamps, the total number in each cabin being 65. These are furnished by a dynamo of the United States motor type, of 150-light capacity, driven by a high-speed 15 h. p. engine. About 20 lights are scattered about the engine and boiler rooms and in the pilot houses. The lights are maintained at full candle power and add very materially to the splendid appearance of the boat's decorations.



ELECTRIC LIGHTING PLANT ON THE ERIE FERRYBOAT JOHN G. McCULLOUGH.

How Should Insulated Wires be Bought?

BY ALBERT SCHEIBLE.

This year promises to eclipse all previous ones in the amount of electrical construction work, and for this purpose many tons of wire of various grades will be used. So the station superintendent who plans an extension, or the contractor in charge of new work, proceeds to map out his lines, calculates the sizes of wire needed and the number of *feet* of each size, and then—buys this wire by the *pound!* Why is this? Is it reasonable to suppose that insulated wire should be sold cheaper by weight than by length, or that it is simpler to buy it by the pound when it is to be used by the foot? Or is there some hidden motive in the practice of many wire manufacturers—which I hope has had its day—of basing the value of an insulating wire on its gross weight? Can it be the intention to distort the relative values of the different wires by basing their comparison on the weight per foot of the covering instead of on the thoroughness and reliability of this insulation?

Let the original motives which led wire manufacturers to list their wires by the pound be what they may, is it not high time that the electrical buyers insisted on comparing the wires on a fairer basis than that of weight? Given a certain size of wire and some insulating medium, then the value of this wire (within reasonable limits) will increase with the thickness of the insulation, and, therefore, with the weight. Yet a closely and evenly applied covering may give better insulation than a greater weight of the same material put on loosely or unevenly. So the weight is no true basis of comparison, and still less so when a number of different insulating materials are used. The weight of the copper itself being constant, it is the weight of different insulations which is compared when wires are sold by the pound. This practice must give the advantage to a covering with plenty of white lead or similar materials, which may be almost worthless as insulation, but which weighs considerably more than the gums and rubber compounds used in higher grades of wire. Nor should a minimum weight per foot of insulation of a given thickness be made any guarantee of excellence, since this would tend toward the loosening of the braiding, and the use of light waxes which may not stand even a moderate rise in temperature.

It must be admitted that the weight of a batch of wire is a good index of its length when the approximate weight per foot is known, and the use of scales in estimating the amount of wire on a reel or coil is perfectly proper. But to place wires covered with white lead, waxes, gums and rubber compounds side by side, and to judge of them by the cost per pound of insulation, cannot possibly lead to fair results, while these materials have such widely different insulating properties. Moreover, instead of leading to the making of a higher and more durable insulation for a

given price, this practice tends to bring out a lighter and less compressed covering. Is it not a far better policy for wire buyers to examine the different grades in the market; to find out what the insulating material is, and how well it is put on; to learn how tough and how durable the covering is, and then to buy it—as they must use it—not by the *pound*, but by the *foot?*

The Highest Economy in the Use of Incandescent Lamps.

BY H. WARD LEONARD.

In operating incandescent lamps of any particular make, their average life will depend upon the incandescence at which they are operated. The higher the incandescence of the carbon filament, the greater the amount of light which will be produced by the expenditure of a certain amount of energy, and the less the average life. Lamps can be made by any manufacturer which shall have practically any desired average life, if the efficiency be not fixed. As we decrease the power necessary, that is, increase the efficiency, we effect a saving in the first investment and in the cost of power required to operate the lamps, but simultaneously we decrease the average life of the lamps, and hence increase the cost in operating due to lamp renewals.

It will, therefore, be evident that, whenever the cost of power and the cost of incandescent lamps for renewals is fixed, there will be a certain definite efficiency and corresponding life, which, for any particular make of lamp, will represent the condition of highest economy in the use of the lamps.

The consumer of incandescent lamps has forcibly brought to his attention the cost of the lamps he uses for renewals, but is usually unable to determine definitely the amount and value of the power required to operate the lamps. Consequently he is frequently led to believe that the cheapest lamp for him to use is necessarily that which gives the longest life. Unless the power required is the same for the different lamps, this is not true, and frequently consumers are operating at very poor economy, and yet believe they are obtaining very good results, merely because their lamp breakage is small.

Let us examine this subject briefly. The measurement of light is rated in "candle power," and the efficiency of production of the light is rated in "watts per candle." The number of watts required by any lamp is the product of the volts and ampères used by the lamp. Thus a 100-volt lamp using one-half an ampère absorbs 50 watts. and if the lamp be one of 16 c. p. the "watts per candle," which is the measure of its efficiency, would be $\frac{50}{16} = 3.1$ watts per candle. Similarly, a lamp of 24 c. p., taking 110 volts and .676 ampère, absorbs 75 watts, and has an efficiency, as before, of $\frac{75}{24} = 3.1$ watts per candle. These two lamps, operated as indicated above, will have the same average life, because the incandescence of the carbon, and therefore the efficiency, is the same in the two instances. Let us suppose this average life to be 600 hours with the efficiency mentioned, namely, 3.1 watts per candle.

Now, suppose we take the lamp designed to be operated at 3.1 watts per candle, giving 24 c. p. at 110 volts, and, instead of subjecting it to 110 volts, reduce the pressure to 104 volts. The reduction of pressure will cause a reduction in the current through the lamp from .676 ampère to .623 ampère; consequently, the watts absorbed by the filament will be $104 \times .623 = 65$ watts. The candle power will be found to be 16 instead of 24, as formerly. The efficiency will be $\frac{65}{16} = 4+$ watts per candle. The average life at this efficiency will be not less than 1,500 hours. Yet it does not follow that the most economical results will be obtained by operating the lamp at such an efficiency and life, although at first such might be thought to be the case.

In order to investigate this question, it becomes necessary to determine the cost of power under different conditions. Perhaps the best authority on this subject is Charles E. Emery, Ph. D., who has thoroughly investigated and reported upon this question. The following values are taken from his report: The cost of producing 1 h. p. for 10 hours per day for 309 days in the year, by means of a first-class engine using 27 pounds of feed water per indicated horse-power per hour, is $52.15, where anthracite coal is $4.17 per ton and where an engineer's wages are $2 per day. Of this $52.15, $24.06 is the cost of the coal, and $28.09 is that due to expenses outside of coal, such as wages, repairs, oil, waste, insurance, taxes, etc. That is, it costs $52.15 to produce $309 + 10 = 3,090$ h. p. hours, hence 1 h. p. hour costs $\frac{52.15}{3,090} = 1.7$ cents.

The cost of the power for operating a 16 c. p. incandescent lamp will, of course, vary with the number operated per horse power. When the lamps have an efficiency of 3.1 watts per candle, twelve 16-c. p. lamps are operated for each horse power in the driving belt of the dynamo. When the lamps have an efficiency of 3.6 watts per candle, ten 16-c. p. lamps are operated per horse power; with lamps of four watts per candle, nine 16-c. p. lamps are similarly operated per horse power, and with 2.77 watts per candle 13.4 16 c. p. lamps. Consequently the cost of the power will be as follows for operating one 16-c. p. lamp for one hour:

	For lamps of 2.77 watts per candle *i. e.*, 13.4 lamps to h. p.	For lamps of 3.1 watts per candle, *i. e.*, 12 to h. p.	For lamps of 3.6 watts per candle, *i. e.*, 10 to h. p.	For lamps of 3.6 watts per candle, *i. e.*, 9 to h. p.
	Cents.	Cents.	Cents.	Cents.
Cost of power per 16-c.p. lamp hour, with power at 1.7 cents per h. p. hour.....	0.129	0.14	0.17	0.19

If the average life of the lamps of 3.1 watts be 600 hours, that of the 3.6-watt lamp will be about 900 hours, that of the 4-watt lamp 1,500 hours, and that of the 2.77-watt lamp 300 hours.

Let us assume that the initial cost of a 16-c. p. lamp is 44 cents, then the cost of renewals per lamp hour would be:

	For lamps of 2.77 watts per candle, *i. e.*, 13.4 16 c. p. lamps to horse power and 300 hours average life.	For lamps of 3.1 watts per candle, *i. e.*, 12 to horse power and 600 hour life.	For lamps of 3.6 watts per candle, *i. e.*, 10 to horse power and 900 hour life.	For lamps of four watts per candle, *i. e.*, 9 to horse power and 1,500 hour life.
	Cents.	Cents.	Cents.	Cents.
Cost of lamp renewals per 16-c. p. lamp hour, with lamps at 44 cents each.....	0.146	0.073	0.049	0.029

Hence the combined cost of both power and lamp renewals would be as follows:

	For 16 c. p. lamps of 2.77 watts per candle and 300 hours average life.	For 16 c. p. lamps of 3.1 watts per candle and 600 hours average life.	For 16 c. p. lamps of 3.6 watts per candle and 900 hours average life.	For 16 c. p. lamps of 4 watts per candle and 1,500 hours average life.
	Cent.	Cent.	Cent.	Cent.
Power.....	.129	.140	.170	.190
Lamp renewals.....	.146	.073	.049	.029
Total cost per 16 c. p. lamp hour when power costs 1.7 cents per horse power hour and incandescent lamps cost 44 cents each.....	0.275	0.213	0.219	0.219

Thus, under the conditions given, the most economical lamps to use will be those of 3.1 watts per candle, and 600 hours average life.

Now, let us suppose that the cost of power varies, as it will in different locations, and under different conditions. It will be noted that of the $52.15 per year for the production of 1 h. p., $28.09, or 54 per cent., is independent of the cost of fuel. Let us suppose that the cost of fuel is nothing, and that the only expenses in the production of power are those due to labor, repairs, insurance, taxes, etc.

	For 16 c. p. lamps of 2.77 watts per candle and 300 hours av. life.	For 16 c. p. lamps of 3.1 watts per candle and 600 hours av. life.	For 16 c. p. lamps of 3.6 watts per candle and 900 hours av. life.	For 16 c. p. lamps of 4 watts per candle and 1,500 hours av. life.
	Cent.	Cent.	Cent.	Cent.
Power.....	0.0684	0.0742	0.0901	0.1007
Lamp renewals.....	0.1460	0.0730	0.0490	0.0290
Total cost per 16 c. p. lamp hour when fuel costs nothing and incandescent lamps cost 44 cents each.....	0.2144	0.1472	0.1391	0.1297

It will be seen that the 4-watt lamp of 1,500 hours' average life becomes the most economical to operate under such conditions.

Now suppose the price of anthracite coal, or its equivalent, to be $2 per ton. We then have the following relations:

	For 16 c. p. lamps of 2.77 watts per candle and 300 hours av. life.	For 16 c. p. lamps of 3.1 watts per candle and 600 hours av. life.	For 16 c. p. lamps of 3.6 watts per candle and 900 hours av. life.	For 16 c. p. lamps of 4 watts per candle and 1,500 hours av. life.
	Cent.	Cent.	Cent.	Cent.
Power.....	0.0991	0.108	0 129	0.146
Lamp renewals.....	0.146	0.073	0.049	0.029
Total cost per 16 c. p. lamp hour where anthracite coal, or its equivalent, costs $2 per ton, and 16 c. p. lamps cost 44 cents each.....	0.245	0.181	0.178	0.175

From the above figures it will be seen that the 4-watt lamp is the cheapest to operate under the conditions given, but the advantage is so trifling that in practice the 3.1-watt lamp would be the best to use, since the lamps fall off in candle power somewhat in long use, and with lamps having an average life of 600 hours the average condition of the total number of lamps on a plant would be that due to 300 hours of burning, whereas the average condition of lamps, having an average life of 1,500 hours, would be that due to 750 hours use, and it is evident that it will be preferable to have lamps which have averaged 300 hours of use, rather than lamps which have averaged 750 hours of use.

It will be seen by the figures given that the life alone is a poor measure of the economy of incandescent lamp, and that in order that a 4-watt lamp should equal in quality a 3.1-watt lamp, its life should be 2½ times as long, and that its average candle power in burning its 1,500 hours should equal the average candle power of the 3.1-watt lamp in burning its 600 hours.

In all instances quoted thus far we have assumed a cost of power based upon its production for 10 hours per day under extremely favorable conditions. In the case of incandescent lighting plants, the load changes widely, and the maximum load is on for only two or three hours. The production of power is much more expensive under such conditions than when the load is constant. Statistics from a very large number of central station incandescent lighting plants, charging an average rate of one cent per 16 candle lamp hour, show that the total cost of power for operating a 16-c. p. 3.1-watt lamp is 0.4 cent per hour. The relative economy in the use of lamps of different efficiencies under average conditions of central station practice is, therefore, shown by the following table:

	For 16 c. p. lamps of 2.77 watts per candle and 300 hours average life.	For 16 c. p. lamps of 3.1 watts per candle and 600 hours average life.	For 16 c. p. lamps of 3.6 watts per candle and 900 hours average life.	For 16 c. p. lamps of 4 watts per candle and 1,500 hours average life.
	Cent.	Cent.	Cent.	Cent.
Power.....	0.357	0 400	0.464	0.516
Lamp renewals.....	0.046	0.073	0.049	0.029
Total cost per 16 candle lamp hour when the power to run a 16 c. p. 3.1-watt lamp cost 0.4 ct. per hour, and lamps cost 44 cts. each.....	0.503	0.473	0.513	0.545

It will be noticed that the operating expenses are 8 per cent. less in the case of a plant using 3.1-watt 600-hour lamps than in the case of a plant using 3.6-watt 900-hour lamps. This is equivalent to an increase in the net profits of 12 per cent. in the case of an incandescent electric lighting company whose expenses are 60 per cent. of the total receipts, which is an average relation between the expenses and receipts in properly operated stations.

Attention is called to the fact that if the life of the incandescent lamp be increased, or the price of the lamp be reduced, the importance of using tne high efficiency lamp rather than the low efficiency lamp becomes even more marked than in the present instance.

Thus, if the average life of a 16-c. p. lamp of 3.1 watts be 1,200 hours, and the cost of the lamp be 40 cents, it will be found that higher economy will result by operating the lamp at 2.77 watts per candle, which will reduce the life to 600 hours. This is shown by the following table:

	For 16 c. p. lamp of 2.77 watts per candle and 600 hours average life.	For 16 c. p. lamp of 3.1 watts per candle and 1,200 hours life.
Power.....	0.357 cts.	0.400 cts.
Lamp renewals.....	0.066 cts.	0.033 cts.
Total cost per 16 c. p. lamp-hour when power for 3.1 watt lamp costs 0.4 cents per hour, and lamps cost 40 cents each.....	0.423 cts.	0.433 cts.

In all systems having a fairly good regulation and distribution of pressure, and where coal costs from $2 upward for the equivalent of one ton of anthracite coal, the 3.1-watt lamp is the most economical.

In alternating systems as ordinarily installed, the variation of pressure is often too great to use the 3.1-watt lamp economically, and the 3.6-watt lamp should be used. Also in cases when the cost of power is extremely low, the 3.6-watt lamp should be used. It will not be found economical to operate the best makes of lamps at more than 3.6 watts per candle under any conditions met with in practice.

The majority of 16-c. p. incandescent lamps on the market to-day require from 57 to 65 watts; that is, to have an efficiency of from 3.6 to 4 watts, and attention is called to the fact that in order to compare in quality with a lamp of 50 watts with a guaranteed average life of 600 hours, there should be a guarantee of 900 hours average life for the 57-watt lamps, and of 1,500 hours average life for the 65-watt lamps, and that even then the consumer will not be operating at the highest economy, as shown above. Furthermore, it must be borne in mind that, by the use of 3.1-watt lamps, the capacity of a plant already using 3.6 watt lamps will be increased 16 per cent., and in the case of a plant using 4-watt lamps, the capacity will be increased 30 per cent.

To express this another way, it may be said that a consumer having a plant using lamps of 3.1 watts, and chang-

ing to lamps of 4 watts, not only suffers the disadvantage due to the fact that he is not operating at the highest economy, but he also immediately increases his investment, interest, depreciation, etc., per unit of light obtained to the extent of 30 per cent. and subjects his dynamo to an overload of 30 per cent., with consequent greatly increased trouble and expense due entirely to the use of the low economy lamps, but frequently attributed to a defect in the dynamo, as it is there that the overload manifests itself.

The Edison Telephone Patents in France.

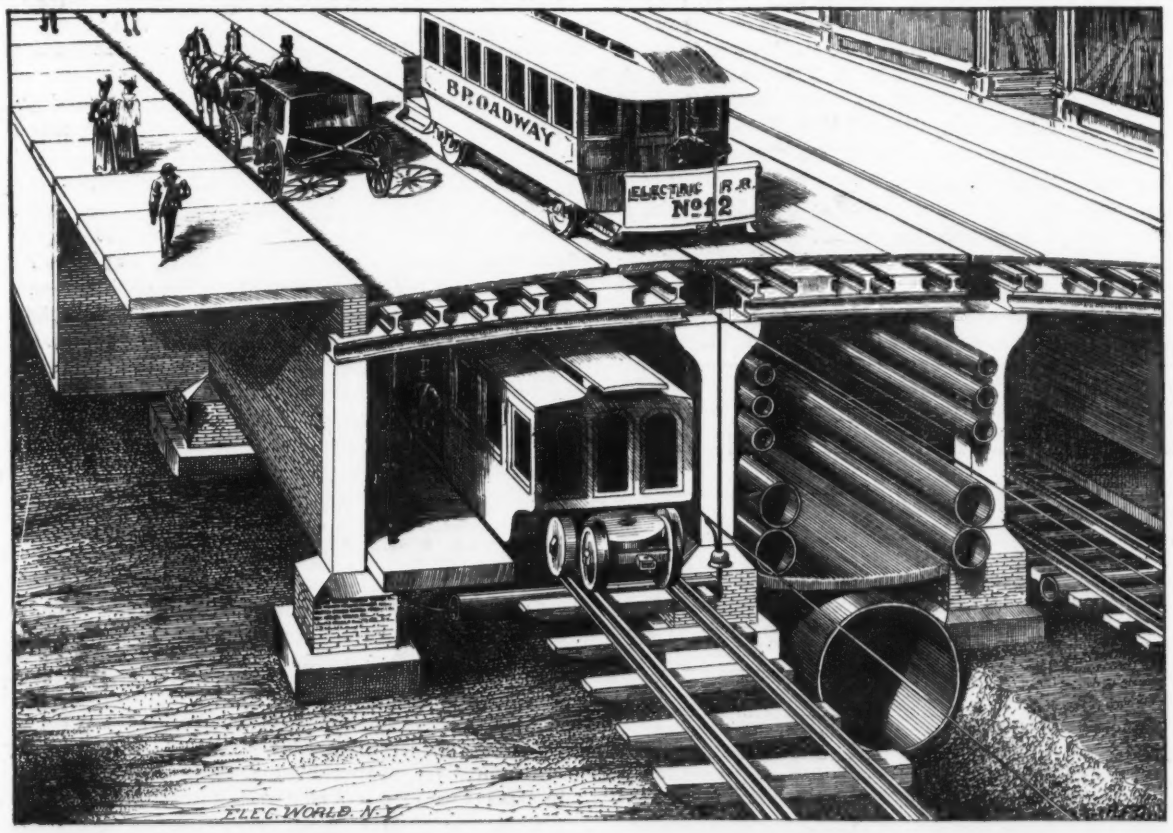
These patents are owned by the Société Générale des Téléphones, and have between eighteen months and two years to run, being dated Dec. 19, 1877, and Jan. 15, 1878. The following is a *précis* of the judgment recently delivered in the French Court of Appeal, in four of the Edison telephone patents:

"The combination of an induction coil and a telephone is a novel application of known parts giving a commercial result. The experts' report makes it clear that the advantages of this combination are considerable, and that it is indispensable in the transmission of articulate speech to a distance. If Elisha Gray and Graham Bell employed this combination before Edison, they only did so in connection with the transmission of musical sounds. The conclusion must therefore be that Edison or his assigns have an exclusive property in the combination of the induction coil and a speaking telephone. The instruments seized are therefore infringements, and may be confiscated, and it is necessary to grant damages to the telephone company; but the court cannot, owing to absence of precise information, at present fix the amount. The demand for further reports and experiments is rejected. The Berliner patent only takes date from Jan. 15, 1878, and not from Oct. 16, 1887."

The Munsie-Coles Underground Railway System.

The Munsie-Coles Subway Company of New York has devised an underground street railway tunnel for rapid transit. In its construction the transverse girders are made in sections to enable the work of placing the vertical columns in position without obstruction to the daily street traffic, and, by a proper distribution of labor and material, make it possible to place the superstructure and new paving in place without any interference with the ordinary travel of the street. By two open slots from the tunnel to the surface of streets, ventilation of the tunnel is provided for while the labor of excavating is in progress.

The vertical depth required from the surface of the street to the bottom of the foundation for the concrete



THE MUNSIE-COLES UNDERGROUND ELECTRIC RAILWAY SYSTEM.

floor is 11½ feet. The superstructure, with the paving, which is of steel, is very light, but strong, and will not require over 14 inches from the top of the paving to the bottom of the transverse girder.

To permit the running of cars of such a height of body as would accommodate ordinary travel, and at the same time utilize the limited vertical space of the tunnel, the company has designed its own car specially for this purpose. The body of the car hangs between trucks of special construction, which admits of the use of a very high wheel to give an easy motion while running at a high rate of speed or in passing around curves.

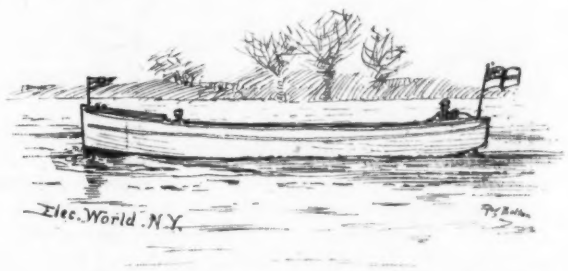
Electricity is intended for the motive power, and, with the open slots already mentioned located between the surface railroad tracks, both underground and surface cars can be worked from the same circuit. The illustration on this page shows the interior of the proposed underground construction, together with the method of operating surface roads by current from the same source.

The Government Launch Electric.

In the accompanying illustrations are shown two views of the electric pinnace recently launched in England. This pinnace was specially built for the English government by Messrs. Woodhouse & Rawson United, Limited, for the conveyance of troops, and is to be used between the dockyards at Chatham and Sheerness.

It is expected that the use of electric pinnaces will present considerable advantages over the existing type of steam pinnace, as not only is the electric pinnace always ready for use at a moment's notice, but the carrying capacity for size and accommodation are considerably greater than that of a steam pinnace. The actual cost of propulsion per mile is estimated not to exceed that of steam vessels with similar carrying capacity, and one great advantage is that no skilled hands are required for stoking and engineering purposes.

The Electric is 48 feet 6 inches in length over all by 8 feet 9 inches beam, with an average draft of 2 feet 3



FIGS. 1 AND 2.—TWO VIEWS OF THE GOVERNMENT PINNACE ELECTRIC.

inches, her full complement being 40 fully equipped soldiers. Her speed on the measured mile will be 8 knots per hour, and for cases of emergency she is fitted with two masts, two balance lug sails and a staysail, thus enabling her to be sailed or propelled electrically and to do the same as a steam pinnace of her size.

The Magnetic Circuit of Transformers: Closed Versus Open.*

BY S. EVERSHED.

(36) But a new era is dawning, and we are gradually coming to recognize the virtue and necessity of stating the unknown laws connecting such phenomena as magnetic force and induction in iron, for example, in the form of a curve which simply gives the observed relation under certain specified conditions. Why attempt to make an empirical formula fit the curve when we have the curve itself? The disastrous effects resulting from the ancient practice of constructing an elaborate formula to fit the observations, and then practically destroying the observations, are familiar to all engineers who refer to their Molesworth. To pack the results of any observations whatever into an empirical formula ought to be a statutory offence. Having entered a protest against the Fourier theorem bogey and empirical mathematics, it must be confessed that the sine function is not to be despised, and when kept within proper bounds makes an excellent servant. In drawing transformer diagrams we shall first assume the E. M. F. wave to be a simple sine function of the time; next, that it is a plain zig-zag; and finally, that it is constant in value while alternating periodically in sign.

(37) Armed with some squared paper, a slide rule, and the cyclic **B H** curve (Fig. 9) corresponding to a maximum induction of 5,000 gausses, let us draw a "no load" diagram for the low-induction closed transformer No. 2. It is best in choosing the horizontal scale to make a complete period correspond with some convenient whole number of squares, irrespective of the true length of period, the latter being usually an incommensurable portion of a second. The maximum value of **B** being known, the curve connecting **B** and time is readily plotted, assuming for the moment that it is a sine function. Next work out the maximum value of the counter E. M. F. in the primary. Since $\mathbf{B}_t = \mathbf{B} \sin 2\pi F t$; **B** being the maximum induction the counter E. M. F. will be $N A \frac{d\,\mathbf{B}}{d\,t} = N A\,\mathbf{B}\,2\pi F \cos 2\pi F t$, and its maximum value is of course $N A\,\mathbf{B}\,2\pi F$. This value being plotted at the epoch corresponding to $\mathbf{B}=0$ the remainder of the curve is easily filled in by taking four or five values for $E' \sin \theta$. This is readily done if the slide rule gives sines, and if not the natural sines of, say, 10, 30, 50, 70, and 80 degrees may be written down from a table and kept at hand. Instead of plotting the counter E curve having a *negative* maximum when **B** is passing through zero from negative to positive, it may be plotted as that component of the impressed E necessary to exactly balance the counter E (Fig. 10). Now, refer to the **B H** curve, and, from the known mean length of the induction path in the core and number of turns in the primary coil calculate the value of the necessary exciting (or magnetizing) current for, say, 1,000, 2,000, 3,000, 4,000, and 5,000 gausses. Owing to the hysteresis there will naturally be two values of C_p for each value of **B**, and care must be taken to plot them in the right order—that is to say, plot them as they occur in going round the cyclic **B H** curve counter clockwise. The curve so obtained is marked X in Fig. 10, and we shall in future call it the X component of the exciting current. The vertical scale to which the exciting current is plotted should be large enough to give a bold curve; it is, of course, out of all proportion to the scales chosen for E and **B**.

(38) There remains to be found the additional exciting current required to neutralize the demagnetizing effect of the eddy currents in the core. As the waste of power due to core eddy currents has already been calculated, we might find the required current by dividing the power by the E. M. F.; but this easy way of arriving at the result does not direct attention to the manner in which eddy currents reduce the effective magnetizing force, and it will be preferable to give in this place a rough method for ascertaining the average value of the demagnetizing effect of eddy currents in thin laminæ.

Referring once more to Fig. 2, and remembering the expressions found for the E. M. F. in and resistance of an elementary path in the section of the lamina, we find the current in it is

$\frac{\dot{\mathbf{B}}\, s^2\, x\, l\, d\, x}{\rho\, r^2}$, and consequently the magnetic force within the element being $\frac{4}{10}\,\pi\, C\, d\,\mathbf{H} = \frac{4\,\pi}{10}\,\frac{\dot{\mathbf{B}}\, s^2\, l\, x\, d\, x}{\rho\, r^2}$, where $\dot{\mathbf{B}}$ must be expressed in volts and ρ in ohms. If this expression is integrated from $x = x$ to $x = r$ we shall have the value of **H** just inside the elementary path $P\,Q$ due to all the eddy current outside it. Call this $\mathbf{H}_x$ and

$$\mathbf{H}_x = \frac{2\,\pi\,\dot{\mathbf{B}}\, s^2\, l\,(r^2 - x^2)}{10\, r^2\, \rho}.$$

What is required is the average value of **H** over the whole section of the lamina, and to get this the surface integral of **H** must be taken from $x = 0$ to $x = r$, and the result divided by the whole area of section; we have then an average value of **H**, which, if applied in the form of a

* From *The Electrician*, London; continued from THE ELECTRICAL WORLD of April 4, 1891.

current entirely outside the lamina, would diminish the **H** due to the current in the primary coil by very nearly the same total amount as does the actual distribution of currents in the lamina. In short the lamina may be supposed to be made up of an inner section or core of non-conducting magnetic substance, surrounded by a thin non-magnetic conductor in which all the eddy currents occur. In this simple case it is quite evident that the **H** due to the eddy current would be uniform over the whole section of the magnetic stuff; and the eddy current would be co-phasal with the E. M. F. ($\dot{\mathbf{B}}$), which is its cause; for there is no other changing induction besides that involved in $\dot{\mathbf{B}}$, to throw the current out of step. All that is necessary to annul the effect of the eddy current is to provide an equal total current round the lamina in the opposite direction—that is, in the same direction as the main magnetizing current but co-phasal with the counter E. M. F. This is true of each lamina in the core, so that the neutralizing current must flow in a circuit round the core—in short in the primary coil.

(39) On performing the integration mentioned in the last paragraph, we find the average eddy current **H** over the whole section of a lamina is $\frac{\pi \dot{\mathbf{B}} t^2}{40 \rho}$ per centimetre in length of core, and it is a maximum when $\dot{\mathbf{B}}$ is so. $\dot{\mathbf{B}} = 5{,}000 \times 2\pi F \cos 2\pi F t$, as we have already seen, and its maximum is $5{,}000 \times 2\pi F = 2.2 \times 10^6$, but as we are throughout working in volts, ampères, and ohms, it must be divided by 10^8 and maximum $\dot{\mathbf{B}} = \frac{2.2}{100}$ volts (per square centimetre of core).

When this value is inserted in the equation for the average eddy current **H**, we find that the maximum reached by this average **H** is .43. Being so small, no great error can be introduced by the fact that we took a rough average value throughout the section of a lamina. The maximum current required in the primary coil to produce a positive **H** = .43 is found from the relation $\frac{4\pi N C'}{10} = .43 \times 147$, where C' is the maximum of C, and 147 is the mean length of the induction path in the core. On working out we find

$$C' = .0225 \text{ (ampères).}$$

This value is to be plotted on the diagram at exactly the same epoch as the maximum counter E, and the whole

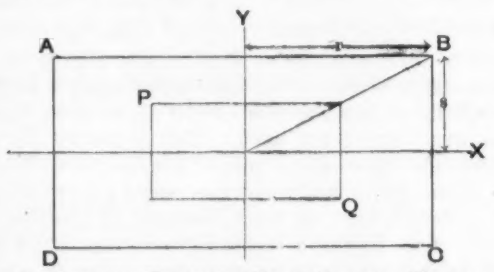


Fig. 2.—Section Through Core Lamina Normal to Induction Path.

wave of the anti-eddy current, as it may be called, is easily filled by working out a few values from the current equation $C = .0225 \sin 2\pi F t$. The wave is marked Y in Fig. 10, and we may call it the Y component of the exciting current.

(40) The diagram now contains a complete account of the whole exciting current considered as two separate currents for distinct purposes; X to carry the core through the requisite cyclic change of induction, and Y to neutralize the demagnetizing force of the eddy currents, so that X may have fair play, so to speak. In Fig. 10 X and Y are added together to form one curve, C, which is the whole exciting current; it is by no means a sine function of the time, nor is it possible in an iron cored transformer to make it so, if the impressed E and **B** waves are simple sine functions; it is not co-phasal with either E or **B**, so that, although it implies waste of power by reason of its not being in step with **B**, the power cannot be found by measuring E and C separately and multiplying their product by the so-called cosine of the "angle" of lag. The expression angle of lag, so freely used by writers when treating of alternate currents, has no meaning when applied to the exciting current of transformers, there being no point on the wave from which lag is to be measured. If the time between maximum E and maximum C is called the lag, then it is exactly a quarter period, and the result would be *no* power; if, on the contrary, the time between $E = 0$ and $C = 0$ is taken to be the lag, the formula $E\,C \cos$ (angle of lag) will make the power far larger than it really is. The true waste power can be readily found from the diagram by integrating $E\,C$ throughout a half period and dividing the result by $\frac{1}{2}T$. This process will be illustrated after the zig-zag and alternating constant E diagrams have been discussed.

(41) The only remaining items to be noticed are the counter E in the primary coil, due to stray induction in the air between the core and the turns of the coil and the loss of volts due to resistance of the primary coil. The stray induction being wholly confined to an air path wastes no power. It requires work to magnetize air, of course, but unlike iron, air gives all the energy put into it back to the circuit again when demagnetized. The stray induction threading the primary coil causes a slight additional counter E. M. F. in it, but it will be understood that the stray **B**, due to the exciting current, must be negligible compared with the whole induction in the core. The core being worked at a low induction density will have an average permeability, perhaps, two thousand times greater than the air, so that if the air path had the same area and length as the core the total stray induction and the counter E due to it would only amount to $\frac{1}{2000}$th of the core induction and its counter E; in fact the additional counter E due to stray induction caused by the exciting current might amount to one volt, as against 2,000 due to the core induction. When the transformer is loaded the stray induction is increased of course, and at full load, when the load current is 3.75 ampères, the total

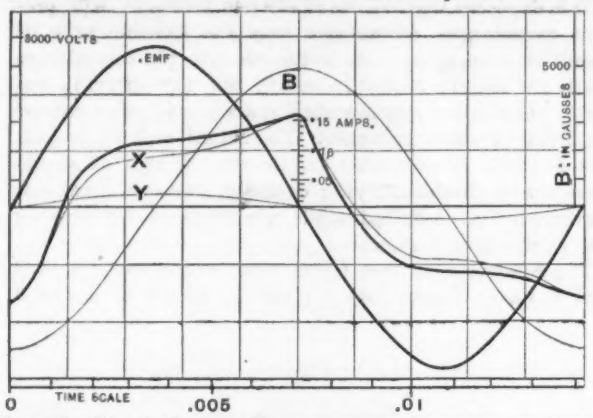


Fig. 10.—No. 2 Closed Transformer. Excited by Sine E. M. F. Output = 0.

B = Induction density in core. X = Current in primary coil to magnetize the core. Y = Current in primary coil to neutralize effect of eddy currents in core. $c = X + Y$ = Total exciting current.

current in the primary is 30 or 40 times greater than the exciting current, and the counter E due to stray induction would be 30 or 40 volts, or 1.5 to 2 per cent. of the total E. M. F. It is this loss of volts which is sometimes spoken of as the drop due to "self-induction"; putting aside the negligible one volt drop due to the exciting current the "self-induction" drop is proportional to load just as the resistance drop is, and the loss of volts due to the two causes together is usually spoken of as the drop due to load. The loss of volts due to the resistance of the primary may be just calculated in order to realize how utterly insignificant it is at no load. The diagram (Fig. 10) gives .162 ampère as the maximum exciting current; the resistance of the primary coil is 7.6 ohms, so that the maximum value of $C\,R$ is less than 1.25 volts, an amount which is invisible on the diagram. This is an important point to remember in dealing with the effect of the irregular shape of the exciting current wave on the E. M. F. and load current waves, for evidently the wave of $C\,R$ would be the same shape as C (being only C multiplied by the constant R), and if it were drawn on the diagram and added to the counter E. M. F. wave in order to find the complete impressed E. M. F. wave at no load, the latter would not be a simple sine wave, being distorted by the addition of the irregular $C\,R$ wave. But the latter is not only absolutely invisible on the diagram, but is really so small that it makes no appreciable distortion in the impressed E wave, and consequently if the counter E is a sine wave the impressed wave must be also.

(42) The fact that $C\,R$ is so exceedingly small shows that for any reasonably well designed transformer having a core of even moderately good iron, the irregular shape of the exciting current wave will not affect the form of

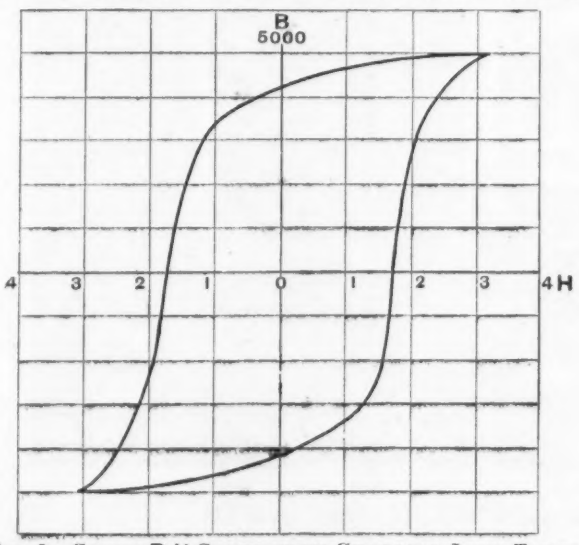


Fig. 9.—Cyclic **B H** Curve from Charcoal Iron, Taken Between + and — 5,000 Gausses. **B** and **H** in C. G. S. Units.

the impressed E. M. F. wave, which may therefore in every practical case be obtained by differentiating the induction wave, whether the latter is capable of analytical expression or not, and conversely the induction wave may be obtained from integration of the E. M. F. wave. When the curve of impressed E M. F. is a sine function, the induction wave is of course a cosine which can be expressed as a sine function. If the impressed E. M. F. wave departs ever so little from a simple sine law, the induction wave alters its shape in a corresponding degree but opposite sense. The next two diagrams will afford a good illustration of this remark.

Note.—If the reader will refer to Sec. 27* he will find a rough method described by which the exciting current for a "hedgehog" was calculated, and the statement made that the values so obtained agreed very closely with the currents actually required by Mr. Swinburne's "hedgehogs." The writer congratulated himself a little too soon on the accuracy of an estimate made on the basis of some dimensions for "hedgehog" transformers kindly supplied by Mr. Swinburne, for, owing to a misunderstanding by which radius of "hedgehogging," centimetres, diameters and inches became inextricably mixed, it turns out that a large overestimate was made; No. 3, as an open transformer (Fig. 7), would only require about 1.4 ampères and not 1.95 as stated. Similarly No. 2 (Fig. 8) would require considerably less than 1 ampère exciting current. The reduced exciting currents would make very little difference to the efficiencies given in tables 12 and 13, but a slight modification of No. 2 will be made in a future article, as its efficiency may be raised to 90.5 per cent. by cutting off nearly half the spherical ends, without increasing the exciting current beyond one ampère.

(To be continued.)

* See The Electrical World April 4, 1891, p. 258.

The Measurement of Electric Power by Means of a Voltmeter.*

BY J. SWINBURNE.

There are various well-known methods of measuring alternating powers. The electromagnetic wattmeter and the electrostatic wattmeter I had the honor of describing to the Physical Society are, as far as I know, the only direct reading power measuring instruments. There are various indirect, but accurate methods, such as double reading electrostatic instruments, Joubert's method, and calorimeter tests. There are a few other ways, such as the split dynamometer method, which can measure power only under particular conditions and leads to erroneous results in such cases as that of a transformer, where the conditions never hold. Electrical powers can, however, also be measured by means of voltmeters.

If the quadrant electrometer connected up as a direct reading wattmeter be analyzed, it will be found that the needle forms with each quadrant an idiostatic voltmeter. One quadrant is in connection with the needle, and thus exerts no force, so the instrument is really a combination of three voltmeters. One measures the difference of potential of the ends of the non-inductive resistance, one the circuit under test, and one that of the circuit and non-inductive resistance together. The Blondlot and Curie electro-

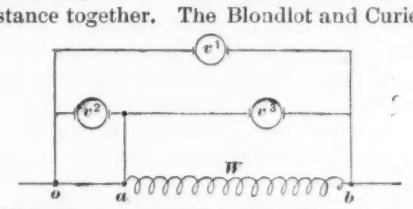


Fig. 1.—Measurement of Electric Power by Means of a Voltmeter.

meter acts similarly, but needs two metallic connections, as it has a split needle. A similar result can be obtained by using three instruments.

Suppose the power taken by part of a circuit—for instance, a closed induction coil for testing iron, a transformer, or a condenser—is to be measured, it is put in series with a non-inductive resistance. In Fig. 1 $o\,a$ is the non-inductive resistance, and $a\,b$ is the choking coil, or whatever is to be tested, which may be called W. A voltmeter, v^1, is put in shunt to the whole arrangement, and voltmeters v^2 and v^3 are put in shunt to the non-inductive resistance and the work W. Let the voltmeters be graduated to read the square of the effective volts. Then, taking o as being at zero potential, the instantaneous potential at a and b may be called a and b. We then have three instruments. If t is half a period,

$$v^1 \text{ reads } \frac{1}{t}\int b^2\,dt$$

$$v^2 \quad " \quad \frac{1}{t}\int a^2\,dt$$

$$v^3 \quad " \quad \frac{1}{t}\int (b-a)^2\,dt = \frac{1}{t}\int b^2\,dt - \frac{2}{t}\int ab\,dt + \frac{1}{t}\int a^2\,dt.$$

Subtract the sum of v^2 and v^3 and v^1, and there remain

$$\frac{2}{t}\int a\,(b-a)\,dt.$$

If the non-inductive resistance is r, the instantaneous electromotive force $a = c\,r$, c being the instantaneous current; so

$$\frac{2}{t}\int a\,(b-a)\,dt = \frac{2r}{t}\int c\,(b-a)\,dt = 2\,r\,p,$$

where p is the power supplied to W. Thus, if the resistance is half an ohm, to find the power with three voltmeters square the reading of each, subtract those of v^2 and v^3 from v^1, and the result is the power in watts. This is independent of any curve of sine hypothesis, and is true whether W is inductive or not.

Interesting as this result is theoretically, it is still more important to find of what practical value it may be. In the first place, it has been assumed that the voltmeters themselves take no current. This is practically true of

* From *Industries*.

electrostatic voltmeters. One voltmeter may be used with switches to vary the connections. This still means three readings, and as a Blondlot and Curie or my arrangement will read power direct, there is no advance in going back to a three-reading method. It allows those, however, who already possess idiostatic voltmeters to use them for measuring power.

The only other available voltmeter is the Cardew. Three voltmeters are now needed for each, for the instrument takes something like 20 to 30 watts at high readings, and putting it in shunt to different parts of the circuit would introduce large errors in such work as transformer testing. If three voltmeters are used simultaneously, the value of r must be found, taking into account the condition that v^2 is in shunt to it. From the power found, that spent in v^2 must be deducted.

This necessitates a knowledge of the variation of resistance of the voltmeter throughout its scale. The cost of three voltmeters, the trouble of calibrating them thoroughly throughout the scale, both for electromotive force and resistance, renders the method rather unpractical, more especially as the resistance does not depend on the reading of the voltmeter, but on the temperature of the whole instrument, which depends on what it has been doing. For testing very large transformers, however, which have losses enormously greater than that of the voltmeter, or, at least, so great that the errors are inappreciable, the method will, I hope, be valuable. The substitution of equivalent resistances also leads to temperature errors.

There is still another method of measuring power, which, I understand, has been invented by Dr. Sumpner and Professor Ayrton, who have communicated it to the Royal Society. If it should turn out to be the same as this, however, they should have credit for priority, especially as regards the use of the ordinary voltmeter for measuring power.

The High-Pressure Transmission of Power Experiments at Oerlikon.*

BY DR. OSCAR MAY.

As is already known, the Maschinenfabrik Oerlikon, in conjunction with the Allgemeine Elektricitäts Gesellschaft, of Berlin, propose to transmit 300 h. p. derived from a waterfall at Lauffen, near Heilbronn, on the Neckar, to Frankfort-on-Main, in connection with the Electrical Exhibition. This transmission is, of course, to be effected by electricity, and the power obtained is to be used both to run motors and lighting installations. The distance between the two places is not less than 112 miles, and the conductor will have to pass through portions of Würtemberg, Bavaria and Prussia. The allowable fall in potential being taken at 10 per cent., and the section of the copper at .06 square inch (38 square millimetres), we find that the current strength must be about eight ampères and the initial pressure about 27,600 volts. A pressure as high as this has not hitherto been applied for transmitting power. The nearest approach to it is the pressure of 10,000 volts in the Deptford mains, which, however, have not yet (Feb. 5, 1891) started work permanently. It was consequently decided, having regard to the enormous length of conductor required, and to the fact that pressures of 20,000 volts and upward are no more dangerous than those of 1,000 volts (inasmuch as either may prove fatal if proper precautions are not taken), to carry on preliminary experiments to prove that currents at pressures hitherto unapproached may be made to satisfy all demands as to reliability in working, insulation, and immunity from danger. The utilization on the spot of natural sources of energy, such as waterfalls and coal beds, and the construction of huge plants for the distribution of the power in a rational manner to various localities, are advantages which must cause all objections to the high pressures to be overcome. The state of affairs is similar to that which obtained before the introduction of steam boilers, gas lighting, railways, etc., with this important difference that whereas these, in spite of rules and regulations, annually give rise to thousands of fatalities, the use of electricity of a "fatally high" pressure, although it has been employed for many years in several countries, notably in Germany, has hitherto caused very few fatal accidents. The objection that the danger of a high pressure current increases with the length of the conductor, is hardly likely to be brought forward now, when conductors of such lengths as to prohibit their being continually watched throughout have frequently been erected without any dangerous results following. The installation carried out in 1882 by Marcel Deprez between Miesbach and the Munich Exhibition may be cited. In this case the Bavarian Government acted most liberally, as it erected the line under the direction of its telegraph engineer, Herr Behringer. Its length was 35½ miles, which was quite long enough to make it impossible to keep the whole of the line under constant supervision. It was worked at a pressure of from 1,000 to 1,300 volts, quite high enough to be considered "fatal," but no accidents happened.

For carrying out the Lauffen-Frankfort scheme, as in that between Miesbach and Munich, the consent and assistance of the local authorities, and, in particular, the postal and telegraph authorities, was necessary. In order to obtain an impartial opinion on the practicability of the scheme, the committee of the Frankfort Exhibition invited these authorities to inspect the model plant erected by the Maschinenfabrik Oerlikon. This inspection took place on Jan. 24.

The arrangement of the test plant was as shown in the accompanying sketch (Fig. 1). The source of power was one of the electromotors in the factory, from which the pulley of the alterrator was driven, the voltage given out by it being capable of regulation between 40 and 100 volts by altering the speed. In the Lauffen installation it is intended to use machines giving 4,000 ampères at 50 volts. In this respect the Oerlikon system differs from most of

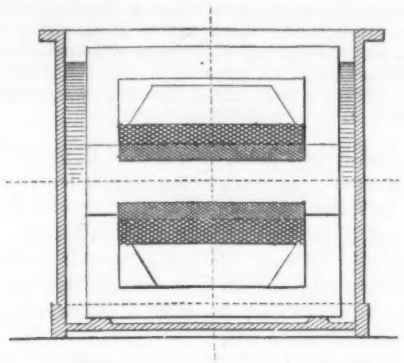


FIG. 2.—SECTION OF THE OERLIKON OIL TRANSFORMER.

those employing alternators and transformers. This arrangement is regarded as decidedly cheaper, besides insuring greater safety in working. From the alternator the low-tension current is led by the primary conductor to the transformer T_1. The primary conductor is provided with a sensitive cut-out S_1, with a two-pole switch E and a two-pole Cockburn cut-out S_2. The working of these cut-outs was entirely satisfactory. The transformer T_1 was on Mr. C. E. L. Brown's system, and consisted of a core built up of sheet iron, on which are wound the primary and secondary windings in coils of circular section. The magnetic circuit is closed by two ⊔-shaped irons, as shown in Fig. 2. Experiments have proved that for such high tensions vulcanite is an adequate insulator

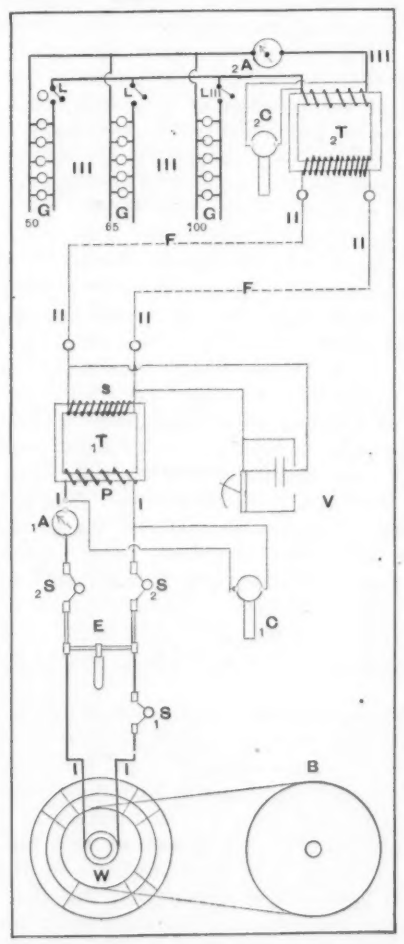


FIG. 1.—DIAGRAM OF THE OERLIKON ARRANGEMENTS FOR TRANSMITTING POWER AT HIGH PRESSURE.

B, source of power; *W*, alternator; *S*, safety fuse; A_1 and A_2, ampère meters; T_1 and T_2, transformers; C_1 and C_2, Cardew voltmeters; *V*, Thomson electrostatic voltmeter; G_{50}, G_{65}, G_{100}, banks of glow lamps for 50, 65, and 100 volts respectively; *F*, main conductor; *I*, primary; *II*, secondary, and *III*, tertiary; *E* and *e*, switches.

so long as it remains undamaged, but that as soon as a crack appears in it sparking takes place through the air which fills the crack. Some varieties of oils have been proved to be as efficacious as vulcanite in the way of insulation; in order, therefore, to prevent a spark passing, the transformer, as shown in the figure, is inclosed in a chamber filled with oil, so that the oil fills the whole of the otherwise unoccupied space, and expels the air which might endanger the insulation. According to Mr. Brown, transformers constructed on this principle are perfectly safe up to pressures of 50,000 volts. The transformer multiplied the pressure 300 times. The currents supplied by the alternator in the present tests were at pressures of 40, 50, 65, 100 and 110 volts, so that in the secondary conductor pressures of 12,000, 15,000, 20,000, 30,000 and 33,000 volts were obtained. The conductor consisted of about one-half mile (1 kilometre) of bare copper wire of 16 inches (4 millimetres) in diameter, which was laid in four parallel lines on the same posts. The line was insulated from earth by Johnson and Phillips' oil insulators. The insulation was tested by allowing a hydrant to play upon the insulators. A 100-volt Cardew voltmeter was connected between the high-pressure secondary conductor and earth, and showed no deflection. No leakage was observed during the recent snowstorms. In the experiments the number of insulators used was altogether 120. In the actual line, copper wire of 16 inches (4 millimetres) diameter will be used in spans of from 260 to 330 feet, so that the test installation represented from 6¼ to 7½ miles of the actual line, so far as regards the insulation resistance of the insulators. The secondary conductor is led to a second transformer, T_2, which reduces the pressure 300 times, so that the current in the tertiary circuit is at the same pressure as that in the primary, which is fed direct by the alternator.

The tests of special interest were those relating to the action of the safety fuses, to the distance through which a discharge could take place through air, and to the working of a telephone circuit arranged parallel to the main wires on the same poles. In order to test the safety fuses, both a direct short circuit and the discharge current were employed. As may be seen from Fig. 1, the fuses were placed in the primary circuit. This was done as it was impracticable to put them in the secondary, since the current strength in the latter is so small that it would have been necessary to use inconveniently thin wires. When the secondary conductor was short circuited by dropping across the two portions of it a short copper wire, the safety fuse was instantaneously melted. As is well known, the production of a momentary short circuit and the consequent melting of a fuse, both produce slight noises; in this case it was not possible for the ear to distinguish even the slightest difference in time between them. The extreme rapidity of the action is further shown by the fact that neither the secondary mains nor the short-circuiting wire showed signs of burning, although the arrangements adopted in the numerous tests made necessitated the contact being made at exactly the same spots both of the short-circuiting wire and the conductors. For producing an arc between the two conductors two wires were attached to them, so that their extremities were 22 millimetres apart. When the pressure in the mains reached 18,000 volts, a momentary arc was started, which was immediately extinguished by the melting of the safety fuse.

To ascertain the influence of the secondary current on a telephone circuit, the latter was arranged on the same posts at equal distances from the two wires. It is to be noted that the secondary conductors were not arranged as shown in Fig. 1, but in four parallel lines, in order to get as great a length of wire as was possible in the limited space. The working of the telephone was quite satisfactory, although a slight noise, due to the proximity of the secondary conductors, could be clearly distinguished. The tests were only of a qualitative nature, but they clearly established that the working of a telephone between Heilbronn and Frankfort can be perfectly well carried on.

The action of the fuses proves that a short circuit, such as may occur through the breaking of a pole or any other accident, will instantly cut off the current. The insulation under the most unfavorable circumstances that could be brought to bear (drenching insulators and posts with water) was practically perfect. It is impossible that any accident could happen through the breaking of a wire, and the installation can therefore be carried out with perfect security.

The experiments just described were made with an ordinary alternating current, but in the Lauffen installation it is intended to employ a totally new system depending upon what has been termed a "rotating" or 'multiple phase," instead of an "alternating" current. This system is the invention of Herr von Dobrowolsky, head engineer of the Allgemeine Elektricitäts Gesellschaft. The current he uses is practically a combination of alternating currents, in which the phases are displaced with regard to each other. As a general rule, three alternating currents are employed, though in special cases the number is increased. The currents are produced by a specially constructed alternator excited by a continuous current, the number of contact rings on the alternator corresponding to the number of currents used. When three currents are employed the angular displacement between each set of phases is 120 degrees. The current impulses are made to follow one another in a fixed order, *e. g.*, either 1, 2, 3; 1, 2, 3; 1, 2, 3, or 3, 2, 1; 3, 2, 1; 3, 2, 1, and they consequently produce a rotating magnetic field. A "rotating" current can therefore, unlike an "alternating" current, be considered to possess a direction of flow. The difference between the three classes of current, "continuous," "alternating" and "rotating," can be clearly brought out by the action of a compass needle when surrounded by the conducting circuit. When the current is continuous, the needle takes up a position determined by the resultant of the earth's field and that due to the circuit, and remains then at rest. If the current is alternating, the needle oscillates about the position it would take under the influence of the earth's field alone. When the current is rotating, the needle commences to rotate on its pivot. If the compass needle is replaced by an iron cylinder, a "rotating current" motor is obtained, which has neither winding, collector, nor contact ring in its moving part, and the armature of which (if it may be so called) is not included in the circuit. Motors made on this principle, like continuous current motors, will start

* From the *Elektrotechnischer Anzeiger*.

with a load, whereas alternating motors will only start from certain positions, even when without load. The "rotating current" motors, moreover, are not larger than those for continuous currents for the same capacities, and they run perfectly quietly. In these respects they are distinctly superior to alternating current motors. They are extremely simple in construction, and work with perfect reliability; they are, of course, not synchronous, and can be regulated to run at very nearly constant speeds between light and full loads. As I am informed by Herr Dobrowolsky, the efficiency for a two-horse "rotating current" motor was found to be 82 per cent. between outputs of 1½ and 2½ h. p.

The "rotating current" transformer transforms all three currents together. It consists of three cores connected together at one end, the other extremity of each being attached to an iron ring. The apparatus, therefore, resembles an iron wheel with three spokes. On each core there is a primary and secondary coil. The whole arrangement is immersed in oil as above described. In driving motors each of the three conductors has to be connected to the coils of the motor fields. Arc lamps and incandescents are connected in equal numbers across each pair of the three conductors.

An installation on this system is in process of erection for transmitting water-power at Bülach to the Oerlikon factory. The available power is 400 to 500 h. p., and drives four turbines, one of which serves as reserve. Each of these is coupled directly to a "rotating current" dynamo; the latter together supply 4,000 ampères at 50 volts. This current is transformed to one of 8 ampères at 25,000 volts, which is conveyed to Oerlikon, a distance of 13½ miles (22 km.), by means of four conductors of bare copper, .16 in. (4 mm.) in diameter, supported on Johnsen and Philips oil insulators. The loss in the wires is 1½ per cent., one-eighth of that allowed for in the Lauffen-Frankfort installation. The Municipal Electric Works at Heilbronn, 12½ miles from Lauffen, are also to be carried on on the same principle, and, in fact, the identical machine used in this case will be employed for the longer transmission to the Frankfort Exhibition.

From the above remarks it will be seen that the employment of the means adopted will enable the project to be carried out with perfect security, and that its satisfactory working can be safely relied on.

Centennial Celebration of the Establishment of the American Patent System.

The congress of inventors and manufacturers of patented inventions, convened to celebrate the beginning of the second century of the American patent system, met in Washington on Wednesday, Thursday and Friday of last week, as already announced in these columns, and was in every respect a most brilliant success. The gentlemen who worked so energetically and so conscientiously to perfect the numerous arrangements for the celebration may well feel proud of the result.

The weather during the meeting was spring-like and delightful, the papers read and the addresses delivered were by some of our most prominent thinkers and public speakers, and were in keeping with the importance of the occasion. The President of the United States, members of the Cabinet, Justices of the Supreme Court, members of both Houses of Congress, officers of the different engineering societies—electrical, mechanical, civil and mining—distinguished educators and many other staunch friends of the patent system, testified by their presence their interest in its preservation and development. Many of the best-known inventors of the country were in attendance, including several whose names have become household words among electricians.

In addition to the interest shown in the proceedings of the congress, an important outgrowth of the celebration was the establishment of a permanent organization of inventors and manufacturers of patented inventions, mentioned more at length in another article in this issue, and from which there is every reason to expect results of a most beneficial character in the years to come.

The first public meeting of the inventors took place on Wednesday afternoon, at 2:30, at the Lincoln Music Hall. President Harrison presided. Beside him on the platform were Secretary of the Interior Noble; Postmaster-General Wanamaker, Chief Justice Fuller and Justices Blatchford and Harlan, of the Supreme Court of the United States; Hon. John Lynch, chairman; Prof. J. Elfreth Watkins, secretary; Marvin C. Stone and George C. Maynard, of the Executive Committee of the Centennial Celebration; Hon. Charles Elliott Mitchell, Commissioner of Patents; Senator O. H. Platt, of Connecticut, Chairman of the Senate Committeee on Patents, and Hon. Carroll D. Wright, Commissioner of Labor. Among the ladies on the platform was Mrs. Alfred Vail, whose husband (uncle of Mr. Theodore N. Vail of the American Bell Telephone Company) was associated with Prof. Morse in the practical development of the telegraph. Prof. A. Graham Bell, inventor of the telephone, with his father, A. Melville Bell, and his father-in-law, Gardiner G. Hubbard, occupied a private box.

Chairman Lynch announced the organization of the congress as completed. The President of the United States had been chosen president of the celebration; Prof. Bell represented the electrical industry in the list of vice-presidents, and among the honorary vice-presidents were the following electricians: Prof. Wm. A. Anthony, Chas. F. Brush, Thos. A. Edison, Dr. Norvin Green, Gardiner G. Hubbard, Prof. T. C. Mendenhall and Prof. Elihu Thomson.

President Harrison in his opening address said:

> It distinctly marks, I think, a great step in the progress of civilization when the law takes notice of property in the fruit of the mind. The ownership in the clumsy device which savage hands have fashioned from wood and stone is obvious to the savage mind; but it required a long period to bring the public to a realization of the fact that it was quite as essential that this property in impalpable thought, taking the shape of things useful to men, should also be recognized and secured. That is the work of the patent system as it has been established in this country. It cannot be doubted by any, I think, that the security of property in inventions is essential and highly promotive of the advance of our country in the arts and sciences. Nothing more stimulates effort than security in the result of effort.

The Rev. Dr. Sunderland, chaplain of Congress, followed with an appropriate prayer, at the conclusion of which the President left the building to keep another engagement, and Secretary Noble took charge of the meeting.

Commissioner of Patents Mitchell then delivered an able and interesting address on the patent system, so full of valuable information that we give it substantially in full in another part of this issue.

Senator O. H. Platt was the next speaker. His subject was "Invention and Advancement," and he delivered in an eloquent and effective manner a most scholarly and carefully prepared address which, like most of the others, while not strictly or wholly of electrical interest, contained frequent references to important electrical inventions. The Senator drew a striking and picturesque contrast by saying that he supposed that had a man who had witnessed the laying of the corner stone of the Capitol been then withdrawn from association with men and to-day returned to the city which he had left as a rural waste, he would think he was in another planet. He would see the Potomac rolling to the sea as of old, the horizon would be bounded by the hills, and the dip of the valley would be familiar to him; but the steamboat would be as strange as were the ships of Columbus to the savages of the Western Hemisphere. He would stand paralyzed at hearing the voice of man transmitted over long distances, and at seeing vehicles move swiftly without apparent propulsive force.

Senator Platt eulogized the spirit of invention which had made this change possible, and mentioned, as a striking illustration of the progress of a century, that while 100 years ago the telegraph was still in the realm of the miraculous, there are now enough telegraph wires to reach from the earth to the moon and back again, with sufficient left to girdle the earth three times. He added that there are hundreds of men to-day who know more of steam and electricity than was ever dreamed of by Watt or Morse, who, after all, were only the prospectors in locating the rich mines of human invention, and continued: Of the seven wonders of the world, only one, the lighthouse of Pharos, was for human good. The seven wonders of the present age, the cotton gin, adaptation of steam to methods of transportation, appliances of electricity in business pursuits, harvesters, the modern printing press, the Biglow loom and the sewing machine were all for the benefit of mankind. Such has been the effect of inventions that the term of human life has been lengthened, and we have more comfort and less want, more pleasure and less pain, more ease and less hardship than any other people who now exist. "If there is a man who does not believe this," said Senator Platt, amid laughter and applause, "let him emigrate to a country where inventions are not known."

Commissioner of Labor Wright showed by statistics that, notwithstanding what are called labor-saving inventions, the number of persons engaged in gainful occupations increases very much more rapidly than does the population. He pointed out that the whole department of electricity, electric lighting, telegraph operations and the telephone are examples of the fact that hundreds of thousands of persons are brought into employment through inventions where no one was ever employed prior to such inventions.

Among the other addresses that followed at this and the subsequent meetings, the most important, from the standpoint of the readers of the The Electrical World, was that by Dr. Cyrus F. Brackett, Henry Professor of Physics in the College of New Jersey, at Princeton. This able and thoughtful paper we publish in full in another column. Thomas Gray, C. E., B. Sc., Professor of Dynamic Engineering Rose Polytechnic Institute, Terre Haute, Ind., also read an admirable paper on "The Inventors of the Telegraph and Telephone," in which he drew attention to the effect of each successive discovery in electricity in producing new proposals for electric telegraphs, and the fact that telegraphy has advanced, as it were, hand in hand with successive discoveries in pure science. Professor Gray mentioned a great many inventors of telegraphs, some of them of considerable merit, whose proposals came before the science and the world seemed to be ripe for the adoption of their inventions. He also pointed out that the credit of inventing the telegraph cannot be given to any one man—that a great many men have added something toward its development.

Professor Gray also pointed out the difference between the Bell, Reis, Dolbear, and other methods for the transmission of speech, and referred to the experiments of Bell, Edison, Tainter and others in this field of invention.

Among those present at the meetings were Prof. E. P. Roberts, superintendent of the Swan Lamp Company, Cleveland; Mr. G. W. Stockley, formerly president of the Brush Company; Prof. Elisha Gray, of Highland Park, Ill.; Prof. P. H. Vander Weyde, of Brooklyn, N. Y.; Messrs. John Milliken, Thos. D. Stetson, Mr. Fowler, E. P. Thompson, W. A. Rosenbaum and L. W. Serrell, New York; C. F. Smith, Newark, N. J.; E. E. Ries and D. G. Weems, Baltimore.

There was an important exhibition of models and early machines and relics during the week at the National Museum.

The early days of telegraphy were uniquely recalled by a piece of the wire over which the first telegraphic message was sent. It is a bit of the copper wire, loosely wrapped with insulating threads, that was stretched about the Speedwell Iron Works. The line was an experimental one, and Alfred Vail sent over it to Prof. Samuel F. B. Morse the words, "A patient waiter is no loser." Below it in the same case was a model of the plow used by Prof. Morse in laying the first telegraph line in the United States, from Baltimore to Washington, and a piece of the wire of this original telegraph line. It was over this wire that the first message reporting results of a Presidential election was sent, and the original strip of paper on which the Morse characters of the message are traced was also exhibited. The message reads: "Hampshire co Va maj. for P [Polk] 11 gain for C [Clay] 171."

The original model of Thomas Davenport's electric motor and circular railway, made in 1837, was on exhibition, as was also the model of Prof. Henry's motor, constructed even earlier, and not so familiar to electricians as its merits and priority in that line would seem to warrant.

Mr. James T. Du Bois was the first to suggest the Congress of Inventors, which he did last summer in the columns of the *Inventive Age*, of which he is editor. Mr. Du Bois also worked earnestly and enthusiastically to get the matter started, and, after the scheme was under way, his exertions ceased not until he had the satisfaction of seeing the celebration the most important of the kind that had ever been held. Professor Watkins, Hon. John Lynch and the other members of the executive committee deserve the highest praise for their unremitting efforts in organizing and carrying out the great work. The residents of Washington, as a whole, particularly the President, the members of the Cabinet, the Board of Trade, whose banquet on Friday night to the members of the principal committees was one of the most noteworthy Washington has ever seen, the various patent officials and patent attorneys, as well as the business men generally, have earned the warmest gratitude of the inventors of the country for the princely manner in which they treated those who attended the congress. The delightful visit to Mount Vernon, the reception by the President and the review of the troops from the white lot, the reception by Secretary Noble and Commissioner of Patents Mitchell at the Patent Office, and the many other honors showered upon the inventors, make the occasion one that none of those present will ever be likely to forget.

Permanent Organization of Inventors and Manufacturers.

The expectation was realized that the outcome of the centennial celebration of the establishment of the American patent system would probably be some kind of permanent association of inventors and those interested in the patent system. The labor of preparing a suitable plan of organization to meet the different interests involved was so great, however, that the association was not formed until nearly eight o'clock on the last evening of the meeting. A National Committee of 100, representing the different States and also the several industries, had been appointed. Only two of the members of this committee were residents of Washington. The other 98 had been selected with great care from every State in the Union. Each Senator and each Representative in Congress was asked to suggest the names of five men that he could recommend to take charge of the formation of any such association that might be thought desirable, and from the names so suggested the committee of 100 was appointed, the number being divided pro rata among the States.

The first meeting of the National Committee was held in parlor 10 of Willard's Hotel at 10 A. M. on Wednesday. The Hon. Gardiner G. Hubbard was chosen chairman. There was absolutely no plan of action to submit to the meeting, and but few of the members of the committee even knew each other; but after some discussion it seemed the almost unanimous opinion of those present that an organization of some sort ought to be formed. A committee was appointed to examine the letters on the subject that the Executive Committee had received from inventors and others who had been heard from in relation to the matter, and another committee was appointed to prepare a plan of organization, should that course be deemed desirable. Neither the members of the National Committee nor, for that matter, of the general body of inventors, seemed by any means agreed as to the shape that such an organization should take, and on many points diametrically opposite views were expressed.

The sub-committee just mentioned called a general meeting of inventors for ten o'clock on Thursday morning,

and submitted a brief report. In the discussion which followed, considerable differences of opinion were manifested—in fact the meeting was of an exceedingly lively character. Everybody seemed to agree, however, that an organization was desirable; the principal difference of opinion appeared to be as to whether such an association should be established now, or the whole matter left in the hands of a committee to report later. Col. J. A. Price, of Scranton, Pa., chairman of the National Board of Trade, and a prominent inventor who has done much for the success of the centennial celebration, was the principal champion of the latter course. He thought the meeting should proceed catiously with regard to so important a matter, for fear of possible failure. He thought a committee should be appointed to get into touch with the 200,000 inventors of the country, and to obtain the views of the manufacturers. Most of the others present, however, including Dr. R. J. Gatling, inventor of the Gatling gun, were of the opinion that something definite should be done before the Congress of Inventors adjourned, so that those present could go home feeling that a beginning had been made, and that each might be able to continue the good work at his own home when the congress was over.

After considerable vigorous discussion, another committee was appointed to look into the whole matter and prepare a plan of organization, and this committee devoted most of the remaining time to the consideration of the subject. It was not until Friday afternoon, however, that the commitee finally reported a constitution and by-laws. The name they suggested was "The American Association of Inventors and Manufacturers," and the objects were given as:

The promotion of progress in the useful arts; the diffusion of practical, scientific, and legal information respecting inventions; the encouragement of favorable and the discouragement of unfavorable laws respecting property in patents; the co-operation of foreign inventors for reciprocal regulations under foreign patent systems, and the proper, just and adequate protection of the rights of American inventors authorized by the constitution of the United States.

After considerable discussion, and some minor changes, the constitution and by-laws were finally adopted and the association organized by electing the following officers:

President, Dr. R. J. Gatling, Hartford, Conn.

First Vice-President, Hon. Gardiner G. Hubbard, Washington, D. C.

Second Vice-President, Mr. Thomas W. Shaw, Phila. Pa.

Third Vice-President, Prof. Wm. A. Anthony, Manchester, Conn., President of the American Institute of Electrical Engineers.

Fourth Vice-President, Hon. Benjamin Butterworth, of O.

Secretary, Prof. J. Elfreth Watkins, Washington, D. C.

Treasurer, Marvin C. Stone, Washington, D. C.

The board of nine directors consists of: Mr. Charles F. T. Brush, of Cleveland, O.; Mr. David G. Weems, the Baltimore electrician, whose experiments in the direction of high speed electric railways are so well known to the readers of THE ELECTRICAL WORLD; Prof. R. H. Thurston, Cornell University; Prof. Otis T. Mason, curator of the National Museum, Smithsonian Institution; Mr. Oberlin Smith, of the Ferracute Machine Co., Bridgeton, N. J.; John H. Bartlett, of Roanoke, Va.; F. E. Sickles, Missouri, inventor of the first steam steering machinery; John Wise Smith, engineer, of Pennsylvania; Hon. David M. Smyth, manufacturer, of New Hampshire, and R. S. Munger, manufacturer of cotton machinery, Alabama.

Mr. E. E. Reis, the well-known Baltimore electrician, was appointed State delegate from Maryland, and Mr. L. W. Serrell, was selected to represent New Jersey.

Electricians cannot but feel that the newly organized association has paid a very high compliment to those connected with the electrical industries of this country by the manner in which the importance of these industries is recognized in the number of electricians selected as officers for the first year. The American Association of Inventors and Manufacturers deserves, and we are sure it will receive, the heartiest encouragement from and co-operation of every one interested in tne progress and development of electricity in America.

Birth and Growth of the American Patent System.*

BY COMMISSIONER CHARLES E. MITCHELL.

The patent system had its birth in a statute against monopolies. That statute was enacted by a British parliament to restrain the British throne. From the earliest times the right to grant exclusive privileges had been asserted as a royal prerogative. Sometimes the power had been exercised beneficently. With vastly more frequency it was employed to bring in revenue to the royal coffers. More and more as the sovereign struggled to govern without the aid of Parliament, the power was abused and perverted. Until the days of Elizabeth, monopolies were conferred upon favorites of the court, extending to the most ordinary article of commerce and consumption. In aid of these illegal monopolies, arbitrary powers of search were granted, and heavy penalties were inflicted upon English merchants for engaging in occupations which had been of common right for centuries. Of course such tyranny could not continue, and in the year 1623 the famous Statute of James was enacted destroying all illegal monopolies by a single stroke, and declaring that in future all patents should be to inventors of new manufactures, and to them only for a limited time. It is to this statute that legal writers ascribe the modern patent system.

Its administration, however, was long pervaded by a spirit hostile to inventors. The benefactor of the public had to crawl before the king as a suppliant for favor. If his cringing was successful, his patent was granted, but he was dismissed with the poor privilege of proving the novelty of his invention as best he could. The patent was not even *prima facie* evidence that the patentee had made an invention. When it came into court it was construed in a technical spirit, a spirit which assumed everything in favor of the Crown and nothing in favor of the subject, and it is hardly too much to say that some of the earlier decisions in patent causes betray a temper that would have better befitted a permit to sell gunpowder in the streets of London.

In view of this judicial hostility, which robbed the law of its beneficence and transformed the statute into an ambuscade, it is no wonder that for 150 years scarcely more than 1,000 patents were granted. It could make but little difference whether patents were denied or, having been granted, were denied protection.

But a more enlightened sentiment developed. Watt had harnessed machinery to steam and Arkwright had harnessed spinning to machinery. The patent to Watt, granted in 1769, had been extended by an act of Parliament in 1775 and had run unscathed the gauntlet of the judge. Patents were granted with increasing frequency, and the useful arts received a mighty impetus. Powerful infringers sought to trample upon the rights of patentees, and law suits followed that were fierce as battlefields. Judges began to regard inventors not as recipients of royal favor, but as public benefactors worthy of the world's great prizes. Then came those days, memorable in judicial annals, when jurists who were in touch with human progress discussed anew the relationship of the inventor to the public, and, as if they had foregleams of a new industrial era, laid down those broader and more generous principles which have become the foundation and framework of the patent law. The Statute of James followed the Mayflower across the ocean. In the year 1641 the General Court of Massachusetts Bay granted a patent to Samuel Winslow for a method of making salt, and prohibited others from making this article except in a manner different from his. In 1646 a patent was granted to Joseph Jenks for an engine for the more speedy cutting of grass, the invention substituting for the short and clumsy English scythe a long, slender blade supported by a rib along its back—a construction easily recognized as that of the modern scythe.

The Constitutional Convention at Philadelphia in 1787 had been in session nearly three months before its attention was directed to patents and copyrights, by the propositions brought in by Mr. Madision and Mr. Charles Pinckney, which resulted in paragraph 8 of section 8 of article 1 of the Federal Constitution. Wise and illustrious men were they, these constitution framers, but they had no conception of the importance of what they did when just before the curtain fell upon their labors they decreed that the exclusive rights of inventors should be secured. They thought they were applying finishing strokes and touches to an edifice which was otherwise completed, when they were really at work upon its broad foundations. For who is bold enough to say that the Constitution could have overspread a continent if the growth of invention and of inventive achievement had not kept pace with territorial expansion? It is invention which has brought the Pacific Ocean to the Alleghanies. It is invention which, fostered by a single sentence of their immortal work, has made it possible for the flag of one republic to carry more than forty symbolic stars.

Under the first patent law, of April 10, 1790, the Secretary of State, the Secretary of War and the Attorney-General were to determine in each case whether a patent should be granted. From April to July they awaited a successful applicant. He comes at last, and three cabinet officers, Jefferson, Knox and Randolph, sitting in solemn dignity, determine that Samuel Hopkins is entitled to a patent for his new method of making pot and pearl ashes.

Does any one say that the office then discharged was unworthy of such a tribunal? Let him then remember that that patent of July 31, 1790, was the first of 450,000 patents. Let him try to imagine the condition of life and society if those patents had never been granted. Let him ask himself what adequate reason exists for the wizard-like transformations of a century excepting the stimulus afforded by patent legislation. Let him compare the saddle and the pillion with the parlor car, the tallow dip with the electric light, the postboy with the lightning mail, the telegraph and the speaking telephone. Let him make a corresponding comparison in every department of life, along every line of progress, and he will see in the signing of that patent to Samuel Hopkins an act of historic grandeur. Fifty-seven patents in all were granted under the statute of 1790. A new act was passed Feb. 21, 1793, which law prevailed, with some modifications, until the great law of 1836 was enacted.

The Act of 1836 created an epoch. An eminent statesman has pronounced it the most important event from the Constitution to the Civil War. Less than 10,000 patents precede it; more than 450,000 have followed in its train. Under it the Patent Office was established; under it the first Commissioner of Patents was appointed, and hardly had the approving signature of Andrew Jackson been affixed before the walls of yonder Doric temple, already completed in design, began to rise. The most important change brought about by the Act of 1836 was the restoration of the examination system and the establishment of an examining corps of experts. The English system, developed on executive lines, relegated all investigation to the courts; the American plan, developed on legislative lines, made the investigation precede the grant.

The importance to inventors of the system of preliminary examination has been declared to be inestimable. It places at the service of the humblest inventor the services of trained experts in law and mechanics. It makes the patent something more than an assertion of right, something more than a challenge to the world to show that the patentee was not the true inventor. It bears testimony that it has been compared with prior patents and publications, domestic and foreign, and with all that has been done in the United States, as far as known, and that the device or process claimed is what it professes to be—a new departure in the arts. Thus the patent acquires an immediate commercial value—a value which is enhanced just in proportion as means are supplied by the government for making an inquiry as complete and exhaustive as it is in human power to make it.

In 1790 three patents were granted; in 1890 the number was 26,292. In 1790 the receipts were about $15; in 1890 they were $1,340,372.60. In 1790 the work could only have required the infrequent services of a single clerk; in 1890 the number of employés, including the examining, clerical and laboring force, was 590 men and women.

The growth of the patent system has been brought about by the friendly laws which I have mentioned, exercising their influence for the most part in four different channels.

1. The patent system has stimulated inventive thought. Benjamin Franklin, a man of science, stood by the side of the old hand lever printing press for a generation and left it where it was left three centuries before by Guttenburg. It remained for Hoe and other inventors who worked under the stimulus of the patent laws and patented their inventions to produce that marvelous machine for disseminating knowledge that has made the world a university. A century ago the apprentice learned the skill and secrets of his craft and jogged along contented with his acquirements. To-day no workman expects to leave his craft or calling without lifting it to a higher plane and providing it with better instrumentalities. A new power of achievement has come into human thinking. Men of all callings seem to have acquired the faculty, and no explanation of the change is even plausible which ignores the stimulating influence of a century of patent law.

2. The patent system has stimulated men to transform their thinking into things. It is a long and toilsome road from the first fugitive suggestion through failure and discouragement and temporary defeat to an invention in a form perfected. If men were not induced by the rewards of a patent system to cling to their new ideas through all the vicissitudes of an inventor's experience, their hands would drop in discouragement. The story of the lost arts has never been told, even by Wendell Phillips, and decades and centuries of possible progress have been wrapped up in inventions which have dawned upon the human consciousness only to disappear and be forgotten.

3. The patent system encourages men to disclose their inventions. The duty of men to disclose their discoveries is one which, if it exists at all, has never been recognized. It is not so, however, when patent laws prevail, and for a hundred years men have hastened to share with the public their newly acquired ideas, because of the invitation contained in the patent system, and the phenomenon of rediscovery is now a very rare experience.

4. The patent system enables inventors to make their efforts fruitful, and saves them from the folly of misdirected labor. The *Official Gazette* of the Patent Office publishes to the world the claims and one or more drawings of each patent. Each number of the *Gazette* may be likened to a series of maps, exhibiting that borderland adjacent to the illimitable unknown upon which the sun of human invention has shed its radiance, while clocks and watches have registered a week of time. Inventors need not and do not, as formerly, delve in exhausted mines.

The centennial exposition at Philadelphia, unquestionably, had a most important bearing upon the patent system throughout the world. Sir William Thomson, after h return to England from visiting the Philadelphia expos tion, made a report to the British government, in which he gave it as his opinion that the unprecedented progress of the United States in the arts and sciences was to be traced in large measure to our patent system. Instead, therefore, of abolishing the patent laws in England as had been advocated, in 1883 a new act was passed upon a more liberal basis. Germany has also revised its patent law. In all these changes the American system has been imitated.

In conclusion, let us hope that the United States, whose place in the vanguard of progress is so largely due to its great inventors, may not now, through indifference to its

* Paper read at the Centennial Celebration of the beginning of the Second Century of the American Patent System at Washington, April 8 (slightly abridged).

patent system, fall back in the procession of the nations. Let us hope that an aroused public sentiment, set in motion by this celebration of the achievements of a century, may demand for the patent system, and for the office which administers its functions, just recognition of its mighty influence and just provision for its needs as it enters upon the second century of its usefulness.

The Effect of Invention upon the Progress of Electrical Science.*

BY PROF. CYRUS F. BRACKETT.

Electrical science really begins with the labors of Dr. Gilbert; these he published in 1600. For almost exactly two hundred years from this date investigation was confined to that domain which is still sometimes called static electricity. A new era, however, dawned in 1800, when Volta gave to the world an invention whose importance can hardly be exaggerated—the voltaic battery.

The simplicity of the device and the wonderful effects which it could produce at once excited the most lively interest, and men of science made haste to investigate it. By means of it Carlisle and Nicholson soon succeeded in decomposing water, and Ritter had a similar success with copper sulphate. Thus commenced a long line of research in electrolysis, which was pursued with great success by Davy and others, and which finally led Faraday to the grand generalization known as Faraday's laws of electrolysis.

Meantime Ritter had noticed that two plates of the same metal, which have just served to convey the current to and from a liquid while undergoing electrolytic decomposition, can, of themselves, furnish a current, and he was thus led to the invention of the "storage battery." It was Volta, however, who gave the correct explanation of its action.

Ritter, Plaff and others observed that the conducting wires of the battery are warmed by the passage of the current, and Curtet, on closing the circuit with a piece of charcoal, produced a brilliant light. Davy systematically investigated these heating effects of the current, employing various metals as conductors, and finally in 1812, on making the current pass between two pieces of charcoal, he produced the well-known electric arc.

Thus, in little more than a decade from the date of Volta's invention, more real progress was made than in any century previous. But the true progress of electrical science is not to be measured solely, or even mainly, by the number nor by the splendor of physical results which attend it, but rather by the insight into the operations of nature which we gain. Viewed in this light Volta's invention was itself the embodiment of a great advance which he had made into an entirely new region. It was not the mere outcome of happy accident, but the result of severely logical reasoning upon facts which he had observed while he was investigating the so-called "animal electricity" of Galvani.

Volta's fundamental research respecting the electrical distribution produced by contact of dissimilar substances afforded him a basis for a rational theory of the action of the battery, and this theory has had a far-reaching influence not only upon the progress of electrical science, but on physical science in general. The voltaic battery rendered possible an observance out of which grew the great invention which we will consider. In 1820 Oersted noticed that a magnetic needle was deflected from its normal position by voltaic current, which was flowing in a conductor near it. He determined the relation of the current to the deflection as respects direction, and sent a brief memoir concerning the matter to well-known scientists.

Arago immediately found that iron filings were attracted by a wire conveying a voltaic current. In order to strengthen the magnetic action of the current Schweigger invented the magnetizing helix, or spiral. By means of this Arago was able to magnetize steel permanently and iron temporarily. The conception of this helix was the first act of invention which was to produce the electromagnet. Yet it was not until 1825 that Sturgeon wound a conducting wire about a core of iron to produce the electromagnet proper. The magnet as it left the hand of Sturgeon was a crude device which the genius of Henry finally perfected between the years 1828 and 1851. Henry constructed several magnets, some of which were wound with long, thin insulated wires, while others were wound with shorter and thicker wires in parallel. These could be joined either in series or in parallel. He thus had the means of studying the effects which a given battery can produce when made to actuate magnets having different windings. He also investigated the effects which are produced by the use of batteries having different electromotive forces. He thus discovered the principles which must be observed in order to secure the best results from the electromagnets under any given conditions. Indeed a careful examination of Henry's work will convince one that he disclosed the same result, by the light of skillful experiment, as is set forth in Ohm's now well-known formula. Moreover, he clearly perceived that the magnet as he perfected it offered the solution of the problem of the telegraph, and he made proof of his provision by actually installing one.

In the hands of Ampère the conducting helix was made, under one form or another, a means of investigation which he pushed with wonderful energy and skill until he unfolded the laws of interaction between magnets and electrical currents, as well as those that govern the mutual actions of the currents themselves. In short, it may be said that as the result of inquiries Ampère was brought to a comprehensive theory of magnetic action which was startling alike for its simplicity and its boldness. It deserves to rank with Newton's theory of universal attraction.

The skillful labor of Faraday and Henry brought to light by the same means the laws of induced currents, and so applied the elements which practical inventors have since combined as to do our bidding, whether it be to illumine our streets and dwellings, push our cars or delve in the mountain for hid treasure.

The electromagnetic phenomena educed by the voltaic current as it flows through a helix constitute the basis of a most admirable system of measurement for electrical quantities, while the helix itself contains in germ the whole family of measuring instruments by means of which such measurements are made. Moreover, the phonomena led the sagacious mind of Faraday to a wholly new way of regarding electrical action in general. He clearly perceived that the old doctrine of the "imponderables" was untenable, and he looked for some common nexus between all physical actions. He was disposed to refer the interactions, which bodies exhibit in consequence of their electrical states, to the medium intervening between them. As light is believed to be transmitted by a universal medium, he sought to find, by experiment, some connection between light and electromagnetic action. On passing a beam of plane polarized light through a block of glass within a magnetizing helix he found that the beam was twisted when the current was made to flow through the helix.

Maxwell undertook the very important work of subjecting the results by previous workers and generally set forth in Faraday's "Experimental Researches" to mathematical discussion which must be considered the final test of truth. Not to mention others, one very important result was his "electromagnetic theory of light." But experiments were wanting, save the single one of Faraday just mentioned, to confirm his deduction. It was reserved for Hertz to supply the necessary evidence in support of Maxwell's theory, which he has lately done by making skillful use of the oscillating discharge of charged conductors, earlier demonstrated by Henry.

Thus it appears that the two germinal inventions which have most influenced the progress of electrical science during our century are the voltaic battery and the magnetizing helix. The one gave us first the means of evoking electrical energy continuously, while the other gave us the means of applying it as we might have occasion. Both contributed powerfully in a direct way to the progress of electrical science by reason of the various and startling phenomena which they revealed.

But it seldom happens that progress continues long in any department of physical science unaffected by the practical application of its results in the arts, and, conversely, such applications almost invariably react to stimulate scientific inquiry. Two principal reasons for this effect may be noticed. When the apparatus and the operations of the laboratory give place to those which are suited to commercial uses, new conditions arise which frequently bring into prominence phenomena before unobserved or inconspicuous. These then become subjects for new investigations, and in due time scientific progress is the result. Thus telegraphy brought its knotty problems as well as its successes, especially when its lines were stretched under the sea, and when one wire was required to do the duty of several, and nothing less than the highest skill and the most severe analysis have sufficed to effect their solution. So, too, telephony was early beset with peculiar difficulties, notwithstanding the simplicity of the means which it employs—thanks to the genius of Professor Bell—but they were such as electrical science has profited from. Speaking generally, it may be said that almost every one of these devices which are in daily use for the transformation of mechanical work into electrical energy, and the converse, has compelled its inventors, in the course of its evolution, to contribute something to the common stock of scientific truth.

It was regretted by Franklin that the results of electrical research had not been turned more to the use of man in practical affairs. Faraday did not doubt that the time would come when that reproach would be removed, but he felt it a duty on his own part to push the work of discovery, and to leave industrial inventions to others. Such applications are now everywhere about us and are rapidly extending. Of course they involve the investment of millions of capital, and this renders it impossible that the great public shall be indifferent to the science upon which they depend. Hence it is that all our schools of technology and most of our colleges have already made provision for training in it.

Every consideration leads us to expect that future progress in electrical science will be more rapid than it has ever been in the past; the present offers the student the accumulated treasures of knowledge and the hope of scientific distinction, as well as that of pecuniary reward. It can hardly be that among the scores of young men to whom those advantages come as inspirations there will not be some who shall prove to be worthy successors of the great men into whose labors they so easily enter.

* Paper read at the Centennial Celebration of the beginning of the Second Century of the American Patent System at Washington, April 8.

Some Notes on Methods of Electrical Construction.

BY FRANKLYN MASON.

The "Tale of Woe" in THE ELECTRICAL WORLD of March 7, 1891, meets with my hearty appreciation. I can fully appreciate the language of a man who wants something to "stick to iron." The electrical industry is to-day controlled by an army of bright, capable and often brilliant men. Many are in a similar condition to that described by the author of the article named above. They know something is wrong and would correct it if they only could; but they lack the early training. They are well educated; many consider themselves very practical; but few indeed have passed years of their life knocking about the shops getting the only training which can give a man good mechanical "horse sense."

The writer has in the past two years been in the employ of two prominent electrical companies. The mechanical de-

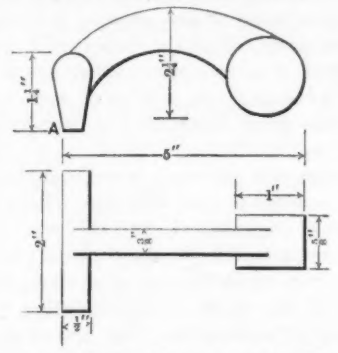


FIG. 1.—A PIECE MILLED FROM STEEL.

sign and construction of each was something to give a practical man a nightmare. Imagine a casting, in tension, of a section throughout the greater part of its length sufficient to stand 20 tons' strain, cut away at one point to less than one-sixth to clear some other part of the machine. Well, but the machine does the work, what more do you want? To be sure there are several pounds of useless material in it, but this makes business good at the foundry and keeps money in circulation.

Another example. A certain piece (Fig. 1) was to be made, and the question arose as to how it should be done. It might be forged, it might be cast and faced with steel at *A*, the wearing point, etc. Was it done in any such simple manner? Not at all. The electrical engineer said: "No matter what the expense, it must be done so and so." And so it was *milled from solid tool steel.*

Does the enormity of this performance strike the reader forcibly? If so, there is some hope for him. If not, then for the sake of the electrical engineering profession let us hope he has no voice in the design or construction of electrical apparatus.

In another case a trolley pole was too weak. It was suggested that it be trussed. So a lot were turned, as shown in Fig. 2. It will be noted that all strain, which before would be distributed along the pole, taking advantage of the elasticity of its entire length, was concentrated at one point, and that the weakest. This was done by particular direction of the chief engineer, a man highly educated, of great scientific attainments, a writer of repute and who, moreover, absolutely controlled the constructive design of the company.

By the way, before I forget this "Tale of Woe," I will remark that sulphur fines at 109° C. and volatilizes at about 300° C. It is therefore not the thing to run red-hot wires through.

When a certain company entered the railway field, it took contract after contract on its reputation for good me-

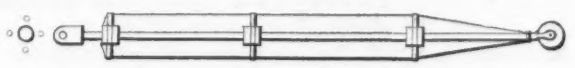


FIG. 2.—TRUSSING OF A TROLLEY POLE.

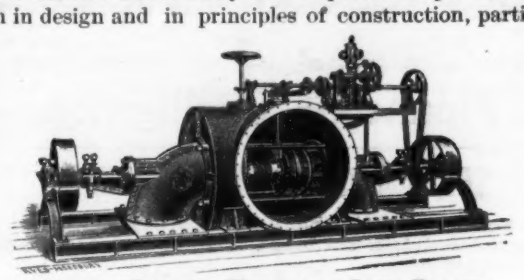
chanical work. When a certain other company put a new motor on the market I noted that the armature pinion had but 14 teeth. For such work 20 teeth should have been provided. Less will cut under, wear rapidly and absorb power in increased friction. This means more coal under the boilers and more cut steel pinions to pay for,—a small matter, to be sure, but hard-headed business men make their dollars by looking after just such small matters.

There is another bane to the electrical business—the glib-tongued mechanic who knows it all. He usually has the inventive faculty well developed and is often a really good workman. Unfortunately his invention is in the direction of ingenious complications. He lacks entirely ability to simplify. The man is rare indeed who can take from a machine some of its parts and increase its capacity. The non-practical man is pleased with the ingenious "wing-wangs" such a man turns out. He admires the slick-working, complicated combination, but fails to see that its construction involves an expense beyond the limits of commercial success.

All this points in one direction. The time will come when the mechanical engineer will control design and construction and the electrician will be his assistant. The day has passed when dynamos were built by "cut and try" methods, and with it secrecy. Thanks to Silvanus P. Thompson and other scientists we can design a dynamo with remarkable certainty of result, since the laws regarding it are written in an open book.

Double Turbine Water Wheels.

Among the oldest builders of turbine water wheels in this country is the Rodney Hunt Machine Company, of Orange, Mass., and the amount of its production in this particular department places it among the largest companies engaged in the special business of manufacturing turbine water wheels. During the course of its long business it has introduced many and important improvements, both in design and in principles of construction, particularly in the manner of mounting turbine wheels on a horizontal shaft.



PAIR OF TURBINE WHEELS IN IRON FRAME.

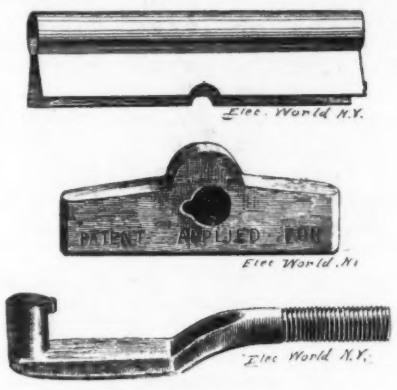
The accompanying illustration represents a pair of wheels in a plate iron case on horizontal shaft, and with separate draft tubes, with driving pulleys, outer bearings, etc., complete with regulator, as designed and made by this company for shipment to the Republic of Colombia, South America, as a motor for an electric light and power plant.

As it had to be transported quite a distance inland on pack mules the several parts of considerable weight were made in sections, so no one single piece would weigh over 200 pounds, excepting five pieces, which were limited to 400 pounds each. Where such requirements are necessary for any reason the work is done in accordance with the specifications.

Wheels mounted in the manner here shown are adapted to any service, either as motors for general manufacturing or for electric light and power plants. In such work, especially where it is to be shipped abroad, simplicity strength and durability are important considerations, and these are recognized merits in all the company's water-wheel work.

The Sterling Trolley Hanger.

The accompanying illustrations show the Sterling trolley wire hanger, together with its separate parts. This piece of apparatus for street railway work is the invention of Mr. S. S. Creider of Sterling, Ill. Fig. 1 shows the completed hanger, Fig. 2 the clasp which passes around the wire, Fig. 3 a slotted block into the edge of which the clamp is passed, and Fig. 4 is the support, which is passed through a hole in the slotted block and is screwed into the core of the bell-shaped insulator. It will be seen by an examination of these parts that when put together and fastened into the position which is shown in Fig. 1 they cannot be detached from each other.



FIGS. 2, 3 AND 4.—STERLING TROLLEY HANGER.

FIG. 1.—STERLING TROLLEY HANGER.

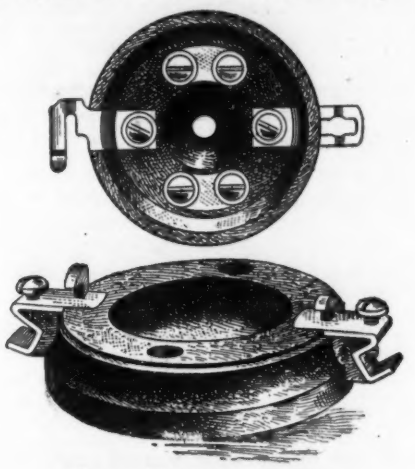
The Use of Oil in Converters.

In connection with descriptions and illustrations which have recently appeared of the use of oil in converters in connection with high pressure experiments of Mr. C. L. Brown, Prof. Elihu Thomson calls attention to the fact that the use of oil in converters was the subject of a patent applied for by him on May 9, 1887, the number of the United States patent being 428,648. Prof. Thomson has used converters or transformers immersed in oil for some time, and some of the commercial work of the Thomson-Houston Company has been done in that way under this patent.

Smith Rosette Cut-Out.

The accompanying cut shows the new Smith rosette cut-out manufactured by the Smith Electric Company, of Attleboro, Mass. The points of superiority claimed for this cut-out are that of extreme simplicity of construction and ease of replacing fuses, no screw-driver being required. It is not affected by atmosphere or moisture, and has a wiping frictional contact which keeps the contact points clean and bright. There is no danger of burning out the fuse in removing or replacing the cover, or of receiving a shock in doing so, as it is not necessary to touch any metal part.

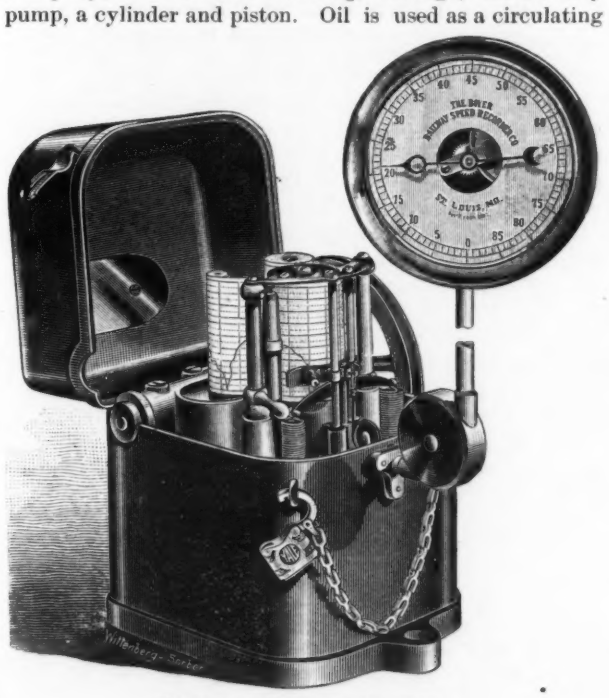
These rosettes are made of molded mica, a material known as "lehte," or in any wood as desired. The molded mica is said to be peculiarly adapted for this use, as repeated tests have shown.



SMITH ROSETTE CUT-OUT.

The Boyer Railway Speed Recorder.

The principal parts of this instrument, which is placed upon the market by the Boyer Railway Speed Recorder Company, 709 Phœnix Building, Chicago, are a rotary pump, a cylinder and piston. Oil is used as a circulating medium, the pump chambers and cylinders being entirely filled. While the machine is at rest, the piston, to which the gauge-wire and pencil are attached, is retained in its lowest position by two coil springs; but when given motion the pump produces a pressure of oil beneath the piston, causing it to rise to a position where an equilibrium is established between the pressure of oil and the tension of the springs; this point is determined by the speed at which the pump is moved, each thirty-second of an inch rise of the piston indicating a speed of one mile per hour.



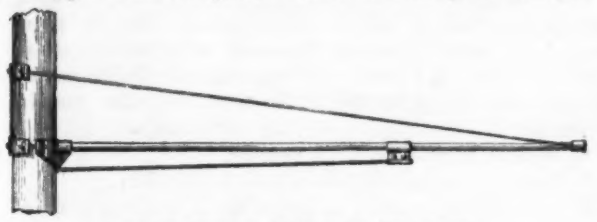
RAILWAY SPEED RECORDER.

Moving around a drum in the upper part of the machine at the rate of one-half inch to the mile is a ribbon of paper, having horizontal and perpendicular lines, each horizontal line from the base representing five miles per hour, and each perpendicular line a mile traveled by the car.

If the car is moving at the rate of 20 miles per hour, the pencil will trace its mark on the fourth line from the base, and for every mile traveled the paper will move under the pencil one-half inch, or the exact distance from one perpendicular line to another. By examining the chart the exact speed at which the car passes any point on the road, the number and location of stops, the distance, speed and location of any backward movement that may have been made, can be determined at a glance. A gauge is provided, the needle of which indicates the speed at any given time. The pencil is a brass wire, and when in good condition makes a distinct line on the prepared surface of the paper. It is held by friction and is forced against the paper by a spring within the holder.

The Giles Street Railway Bracket.

In the accompanying illustration is shown a bracket intended for use in street railway construction, which is manufactured by Mr. D. C. Giles, of Elmira, N. Y. The arm of the bracket is made of a steel tube, the truss rods being also of steel. In the construction of the bracket no castings are used except at the extreme end, where a malleable casting weighing about three-fourths of a pound is used. The upper truss rods pass on either side the pole, thus preventing any swaying motion, while the lower rod prevents the bracket from being pressed upward when the trolley wheel passes under it. The plates which clamp the bracket to the pole are made of the best quality of iron or steel. These brackets are made in several standard sizes, and are also manufactured to order in any length required.

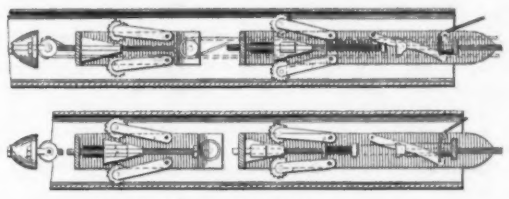


GILES' STREET RAILWAY BRACKET.

Cope's Pilot Line Apparatus.

The object of this apparatus, which is the invention of Mr. J. T. Cope, of Philadelphia, is to lay the pilot or lead line through electrical conduits quickly and cheaply, and to avoid the necessity of blowing out impure gases, as the operator can work above ground if desired.

The machine consists of two travelers arranged on two parallel bars. One traveler slides freely on the bars while the other is firmly attached to the base of the bars. A rope sliding through a pulley attached to the top of the parallel bars is fastened to the wedge which spreads the clamps of the movable traveler. When this rope is pulled the movable traveler is drawn to the end of the bars, where it clamps the sides of the conduit. Then the other rope, which passes through a pulley attached to the movable traveler, and which is fastened to the fixed traveler, is pulled; the wedge in the sliding traveler is drawn back, spreading the clamps; the clamps of the traveler attached to the parallel rods are released, and the bars and traveler attached to them slide forward some five feet, where the traveler becomes fixed to the conduit. This operation is repeated until the creeper has reached the next manhole.



COPE'S PILOT LINE APPARATUS.

The machine is so arranged that, should the "duct" be permanently obstructed, it can be thrown out of gear and withdrawn. A line can be run through iron, wooden or cement conduits of 400 or 500 feet in length in 10 to 15 minutes by one man, or in half that time by two operators. It passes through subsidiary boxes without difficulty. Each full movement of the operating lines moves the machine 4½ to 5 feet. The diameter of No. 2 machine is 1⅝ inches when closed, extending to 3 inches by 6 feet long, and, being pliable, can be bent to enter any subway.

Adjustable Cross-Over for Electric Railways.

The adjustable cross-over shown in the accompanying illustration may be adapted to crossings at any angle, and furnishes a smooth passage and unbroken contact for the trolley, whether the trolley wheel be deep or shallow.

ADJUSTABLE CROSS-OVER FOR TROLLEY LINES.

This is accomplished by making an upper flange or plate on each of the four arms, as shown in the cut, extending a short distance out from the centre at a slightly greater incline than that of the trolley rib. The trolley rib is then made very shallow and the centre post very small and short, so as to form no obstruction to the shallow wheels, the deeper wheels being provided for by the flange on the wheel coming gradually in contact with the face of the plate on the arm, which, in connection with the centre plate and that on the opposite arm, forms a smooth surface over which the trolley wheel passes. There is thus no arcing or jar in crossing, whatever the depth of the wheel may be, the flange of the deeper wheels merely reaching the plate on the arm sooner than the flanges of the shallower wheels. This is an important feature, as the depths of the wheels are continually varying by wear. The crossing, which is put upon the market by the Elec-

trical Supply Company, of Chicago, is made of brass, has clips to fasten it to the lines, is light and graceful in form, and is made of such length that the slope is very gradual.

The Work of the Dow Motor in Torpedo Service.

BY J. H. DOW.

The estimate of power developed by the Dow steam turbine given herewith is from data obtained in speeding up the fly-wheel of the Howell torpedo. The fly-wheel storage of energy is an exact measure of the net development of power in excess of all resistances. To determine the actual power of the motor the following data must be used:

1. Weight of fly-wheel, 135 pounds.
2. Radius of gyration of fly-wheel, 5.57 inches.
3. Weight and radius of gyration of rotating parts of motor. These are approximately equivalent to 12 pounds weight distributed around a circle of one foot circumference. Hence weight = 12 pounds, and radius of gyration $= \frac{1 \text{ foot}}{3.1416 \times 2}$.
4. Resistances by atmospheric disturbance and friction. The total resistance may be determined with moderate approximation by noting the steam pressure required to maintain a given speed, and assuming that the powers developed by the motor are in the ratio of steam pressures. To maintain a speed of 10,000 revolutions per minute requires a steam pressure of 22 pounds; average consumption of pressure to overcome resistance in speeding from 9,000 to 10,000 is about 20 pounds; average in speeding from 8,000 to 10,000 is about 17 pounds.*
5. Speed of rotation in revolutions per minute; maximum, 10,000.
6. Time consumed to develop the given speeds as follows:

TABLE OF SPEEDS, TIMES AND STEAM PRESSURES ON THE MOTOR. COPIED FROM RECORD BOOK OF HOTCHKISS ORDNANCE COMPANY. THREE TRIALS, AUG. 26, 1890.

	First trial.		Second trial.		Third trial.	
Revolutions per minute.	Time in secs.	Lbs., gauge pressure.	Time in secs.	Lbs., gauge pressure.	Time in secs.	Lbs., gauge pressure.
8,000	103	57	95	60	92	59
9,000	117	56	109	60	104	60
10,000	134	55	126	58	121	59

Two methods may be used to calculate the power of the motor.

First Method.—Estimate the total storage of energy in the fly-wheel and motor when running at 10,000 revolutions. Then, since the power of the motor is zero at the instant of starting, and increases with the increase of speed, reaching its maximum at the instant that full speed is reached, we may assume that such increase of power is in constant ratio to the increase of speed. The power of the motor at full speed and full load will then be exactly double the average power while speeding up from start to full speed, and the true power of the motor will be estimated by the formula,

$$\frac{\text{minutes required to speed up} \times \text{ft. lbs. of storage} \times 2}{33{,}000} =$$

horse power of the motor at full load and full speed. But the assumption that power and speed increase in constant ratio may be inaccurate.

Second Method.—Estimate the foot pounds of storage in speeding from 9,000 to 10,000, or from 8,000 to 10,000 revolutions per minute, then horse power of motor at average speed of the run =

$$\frac{\text{duration of test in minutes} \times \text{ft. lbs. stored during test}}{33{,}000}$$

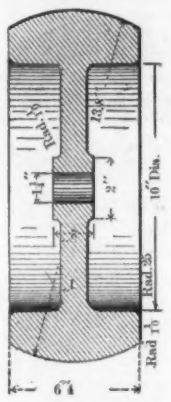
Estimate of total storage of energy in fly-wheel and motor when running at 10,000 revolutions per minute:

$5.57 \times 3.1416 \times 2 = 35$ inches, circle of gyration of the fly-wheel. $\frac{35 \times 10{,}000}{12} = 29{,}166$ feet per minute, velocity of circle of gyration. $\left(\frac{29{,}166}{60 \times 8.02}\right)^2 = 3{,}673.6$ feet, height from which a body would fall by gravity to acquire the velocity of 29,166 feet per minute. $3{,}673.6 \times 135 = 495{,}936$ foot pounds of energy stored in the fly-wheel. And $\left(\frac{10{,}000}{60 \times 8.02}\right)^2 \times 12 = 5{,}244$ foot pounds of energy stored in the motor. $495{,}936 + 5{,}244 = 501{,}180$, or say 500,000 foot pounds of energy = total storage in fly-wheel and motor.

Now, since the stored energy is as the square of the speeds, we have $9{,}000^2 : 10{,}000^2 :: .81 : 1.00$. $1.00 - .81 = .19$. $500{,}000 \times .19 = 95{,}000$ foot pounds stored while gaining from 9,000 to 10,000 speed. And since each of the three trials made this gaining in 17 seconds, power developed was $\frac{60 \times 95{,}000}{17 \times 33{,}000} = 10.16$ h. p. The average steam pressure for the three trials was $\frac{56 + 55 + 60 + 58 + 60 + 59}{6}$ = 58 pounds. Deduct from this 20 pounds consumed to overcome resistances and 38 pounds is the average net effective pressure. Then if powers developed by the motor are in the ratio of their steam pressures a pressure of 100 pounds and average speed of 9,500 would give $\frac{100 \times 10.16}{38} = 26.7$ h. p.

The power of the motor when calculated from the energy storage between 8,000 and 10,000 speeds, assuming 17 pounds pressure to be consumed by resistances, is as follows:

Average duration of the three tests $= \frac{31 + 31 + 29}{3} =$ 30.33 seconds. Then $8{,}000^2 : 10{,}000^2 :: .64 : 1.00$. $1.00 - .64 = .36$. $500{,}000 \times .36 = 180{,}000$ foot pounds gain in energy in speeding from 8,000 to 10,000 revolutions per minute. Then $\frac{60 \times 180{,}000}{30.33 \times 33{,}000} = 10.79$ h. p. net. This was developed with an effective pressure of $58 - 17 = 41$ pounds.



DIMENSIONS OF FLY WHEEL.

The power of the motor when using a steam pressure of 100 pounds and running at the average speed of $\frac{8{,}000 + 10{,}000}{2} = 9{,}000$ will be $\frac{100 \times 10.79}{41} = 26.3$ h. p.

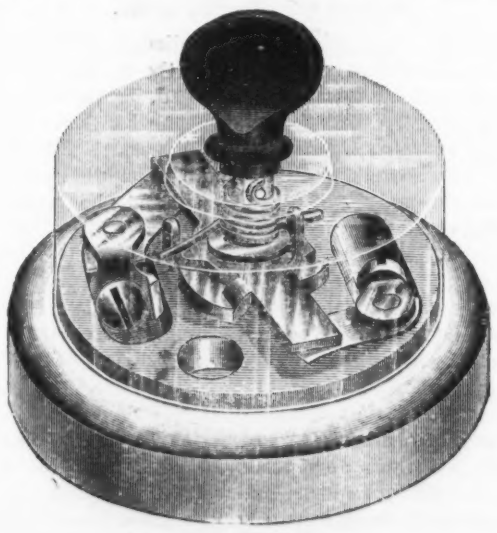
The torpedo service motor works smoothly and safely with 150 pounds steam pressure, and will develop at that pressure about 40 h. p. The weight of the motor, now 150 pounds, may be easily cut down to 100 pounds, and it will then develop one horse power for every two and one-half pounds of weight.

Electrical Utilization of Water Power.

Mr. Madison Buell read an able paper on the above subject at a recent meeting of the Buffalo Electrical Society, in which a very comprehensive review was given of the different water-power plants of the world which are utilized for the generation of electricity for lighting and power purposes. Several plants in Europe, especially those in Switzerland utilizing the Alpine falls, and in Austria and Italy, were described. Two water-power plants in South Africa, furnishing lights for two gold mines, were referred to as typical installations of the "Dark Continent." Several plants in this country, with which many of our readers have already become acquainted through the columns of THE ELECTRICAL WORLD, were chosen as representative American installations. Among these may be mentioned those at Aspen, Colo.; Veazie, Me.; Dover, N. H., and Spokane Falls, Wash. A summary was also given of the work thus far completed at Niagara Falls for the Cataract Construction Company.

The Sperry Snap Switch.

The "4 S" or "Sperry special snap switch," which is shown in the accompanying illustration, has recently been placed upon the market by the Sperry Electric Mining



SPERRY SNAP SWITCH.

Machine Company, of Chicago. The working parts of this switch consist of but two pieces, both of which are shown in the cut, viz., the spring and lever. The ratchet which controls the movement of the lever is solid with and forms part of the base of the switch. The double break made by the switch measures more than 1¼ inches and will break several times the voltage ordinarily used in incandescent lighting. The action of the lever upon the terminal contacts always keeps them clean and bright.

The handle is so arranged as to unscrew when turned backward for removing the cover. A number of new and special features of construction have been utilized, which are the results of experience, and have been recommended by first-class line men. Among these will be noticed the method of making connection. The terminal is depressed below the surface at an angle, so that the screwdriver can easily reach it from the top, requiring no extra perforation for the admission of the wires. The wires entering the switch are always open to inspection by simply removing the cover.

This switch is extremely neat in appearance, the base for the 10-ampère size measuring less than three inches over all.

* Atmospheric disturbance is great at high speeds, and increases rapidly as speed increases. The true-running, polished rim of the fly-wheel, which is 13.8 inches in diameter, travels through the air at the rate of 6.8 + *miles per minute* when at its speed of 10,000 revolutions per minute, and creates a *powerful blast.*

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

This department will be pleased to answer any question in regard to electrical stocks and bonds. Address FINANCIAL EDITOR ELECTRICAL WORLD.

G. J. S.—The total issue of capital stock of the American Bell Telephone Company is $15,000,000 besides an issue of $2,000,000 bonds known as '7'5.

F. Z. Maguire & Co., electrical securities, 18 Wall street, New York, send the following closing quotations of Electric Stocks, on Saturday, April 11, 1891, in New York, Boston and Washington:

Name of Stock.	Par.	Capitalization.	Bid.	Ask'd.
NEW YORK.				
Western Union Telegraph Co.	100	86,200,000	81½	81¾
American Telegraph & Cable	100	14,000,000	83	85
Central and South American	100	5,000,000	*145	160
Mexican	100	2,000,000	*210	220
Commercial Cable Co	100	7,716,000	105	106
Postal Telegraph Cable	100	5,000,000	39	41
Edison General Electric Co.	100	9,503,500	98	100
Consolidated Electric Light	100	1,922,400	....	....
Edison Electric Illuminating Co.	100	2,567,800	78	....
United States Electric Light.	100	1,500,000	30	....
North American Phonograph	100	6,200,000	....	....
BOSTON.				
Thomson-Houston Electric Co.	25	6,000,000	46½	47
" " preferred.	25	4,000,000	25¼	25⅝
" " Series C.	10	400,000	9¼	10
" " Series D.	10	120,000	7	7¼
" International Co.	100	1,000,000	....	....
Thomson Welding Co.	100	1,000,000	....	....
" European Welding Co.	100	1,000,000	....	65
Westinghouse Electric Mfg. Co.	50	5,000,000	13	13⅛
Ft. Wayne Electric Co.	25	4,000,000	12¾	13¼
Telephone:				
American Bell.	100	12,500,000	198½	199½
Erie	100	4,800,000	49½	50
New England	100	10,504,600	51	....
Mexican	10	1,280,000	85c.	90c.
Tropical American	10	400,000	85c.	90c.
MISCELLANEOUS.				
Edison Phonograph Doll	10	1,000,000	50	1
WASHINGTON.				
Pennsylvania Telephone	50	750,000	25	....
Chesapeake & Potomac	100	2,650,000	57½	60
American Graphophone	10	600,000	5½	6
United States Electric Light (Washington)	100	300,000	167	175
Eckington and Soldiers' Home Electric Ry.	50	352,000	56	57
Georgetown and Tennallytown	50	200,000	62	64

*Ex dividend.

Chicago Quotations.—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on telephone and electric light stocks as follows:

Chicago	$225@$245	Cumberland	$60@ $62
Central Union	56@ 57	Wisconsin	118@ 120
Michigan	85@ 86	Bell of Missouri	160@ 165
Great Southern	30@ 32	Iowa Union	20@ 22
Colorado	34@ 36	Missouri and Kansas	54@ 56
Rocky Mountain Bell.	40@ 43		
ELECTRIC LIGHT STOCKS.			
Chicago Arc Light and Power	$102@$103	Chicago Edison Co.	$140@$150

Railroad Shares Losing Ground.—If you want to appreciate the dullness of railroad shares, take a walk on Wall street and compare it with the street five years ago. Instead of a hustling, bustling mass of men, with messengers hurrying from Exchange to office and *vice versa*, you have a quiet crowd of men, who represent anything but the prosperity of several years ago. The little advance of the railroad share market, which was mentioned last week, has almost disappeared at this writing, and the brokers are again disappointed at the prospect of the market. Some brokers are of the opinion that the "unlisted department" is responsible for the decline of business, and that outside stocks are drawing attention from railroad shares. The writer thinks it means that the people are getting tired of waiting for a better condition of railroad stocks, tired of a "professional market" and manipulation in general, and see that there is less manipulation in outside shares and more profit.

Electrical securities have been active during the week, and many of the leading stocks have had a rising market. Thomson-Houston preferred and common Westinghouse and Bell Telephone stocks were among the number. Edison stock fell to 99 on Thursday, and closed at 98 Saturday.

United Electric Traction Company.—This stock is offered freely to a very limited market. The statement is made that the storage battery cars that were running experimentally on the Fourth avenue line have been taken off. There has been much difficulty caused by the patent litigation, and the Brush, Julien and Accumulator companies are at a standstill so far as storage battery matters are concerned, until the courts decide to whom belongs the fundamental patent. The experiment, it is said, has not been a failure, but the company is unwilling to continue until the fight on the patent is decided.

Erie Telegraph and Telephone Company.—A stockholder of the above company has been asking questions concerning the proposed sale of Southwestern territory. He says that holders of Erie stock have been told that this branch company was growing rapidly and showing increased profits, and he would therefore like to know why the company should part with its assets, which yield steadily increasing profits, for 50 per cent. of the par of its own stock, and also wants to know if the Erie company is in debt. The company gave the following information by way of answer: The assets of the Erie Telephone and Telegraph Company consist of a 70 per cent. interest in the Northwestern Telephone Exchange Company, a 65 per cent. interest in the Cleveland Telephone Company, and a 70 per cent. interest in the Southwestern Telegraph and

Telephone Company, the American Bell Telephone Company owning the balance in each company. The directors of the corporation believe that the interests of the company could be greatly advanced if a local interest was created, particularly in the Southwestern company, which operates in the States of Arkansas and Texas. With this in view they have favorably considered a proposition from a Texas syndicate to sell a portion of their holdings in the Southwestern company (the Erie company retaining a controlling interest), and giving to said syndicate an option to purchase the whole property should they so desire. The price to be received, as set forth in President Sprague's letter to the stockholders, is proportionally equivalent to the present market price of the stock of the Erie company, and it can readily be seen that, with the local interest created or the entire section disposed of at the present market price, the company would be in a far better condition, retaining its interests in the Cleveland and Northwestern companies, than it is at present, for the principal reason that the Cleveland and Northwestern companies are increasing more rapidly in earnings and the expense of operation is in a great proportion less.

Westinghouse.—The statement is made that Mr. Westinghouse has completed his financial arrangements for the benefit of the company, and that prominent parties in New York have advanced the money necessary. The stock rose during the week on the strength of the report. F. Z. M.

NEW INCORPORATIONS.

The Royersford (N.Y.) Light and Power Company has been incorporated with a capital of $1,000.

The Bridgeport (Ala.) Electric Light and Ice Company has been incorporated with a capital stock of $60,000. The incorporators are: A. L. Soulord, E. A. Hoffman, Jr., F. J. Kilpatrick and R. C. Gunter.

The Waterville (Wash.) Improvement Company has been incorporated by ten prominent Seattle capitalists, whose intention it is to erect water-works and a system of electric lights at Waterville at once.

The Anglo-Canadian Electric Storage and Supply Company, of Ottawa, Canada, is about to be incorporated for the purpose of manufacturing, selling and leasing secondary batteries and all kinds of electric supplies and appliances.

The Union Electric Works, of Chicago, has been incorporated to manufacture and deal in all kinds of electrical devices and appliances. The capital stock is $50,000. The incorporators are F. C. Rutan, Ernest William Cooke and William W. Anderson.

The East District Electric Light and Power Company, of Brooklyn, N. Y., has been incorporated with a capital stock of $300,000. The incorporators are: T. H. Blanchle, E. S. Seeley, Theo. Dow, C. A. Smyler, H. H. Downes, S. J. Burrows and Thomas Black.

The Dawn Electric Company, of Chicago, Ill., has been incorporated to do an electrical construction business and control, operate and sell electric light and power apparatus. The capital stock is $20,000, and the incorporators are Henry P. Williams, J. A. McEntee and J. M. Glenn.

AFFAIRS OF THE COMPANIES.

The Empire City Subway Company, of New York City, has filed certificate with the Secretary of State increasing its capital stock from $500,000 to $1,000,000.

The Ware (Mass.) Electric Company has chosen the following officers: President, Frank M. Sibley; vice-president, Andrew Bryson; secretary, William C. Eaton.

The Olean (N. Y.) Electric Light and Power Company, at its annual meeting last week, voted to increase the capital stock $5,000 to provide for necessary additions to the electric light plant which are now being made.

Nashville, Tenn.—The Thomson-Houston Electric Company at Boston is to purchase the Capital Electric Company, the stock and bonds of which company have heretofore been held by the Nashville Lighting and Power Company.

The Wyoming (O.) Light, Water, Heat and Power Company held its annual meeting at the office of the company last week, and elected the following directors: George Kinsey, Julius Beckenstein and O. Reich. The proposition to increase the capital stock $50,000 was carried.

The Lancaster (N. H.) Electric Company held its annual meeting last week, and it was voted to increase the capital stock to $18,000. The following officers were elected: President, H. W. Burgett; Secretary-Treasurer, W. E. Bullard; Directors, H. W. Burgett, Frank Smith, Lewis H. Rogers.

The Kettle Falls (Wash.) Light and Power Company, at its meeting last week, chose a board of directors, and the following officers were elected: President, G. H. Smith; vice-president, J. O. Roe; secretary, H. J. Amos; treasurer, A. A. Davis; manager, T. J. Reynolds. The object of the organization is to furnish electric light and power to the citizens of Kettle Falls. It is expected that the plant will be in full operation inside of 60 days.

Jenkintown, Pa.—At a recent meeting of the stockholders of the Jenkintown Light Company the following officers were elected for the ensuing year: Samuel H. Gilbert, president; Chas. F. Wilson, treasurer; C. M. Blanchard, general manager; L. R. Schultz, secretary, and William Hagerman, superintendent. This company has increased its capital stock from $40,000 to $100,000, and has placed an order with Mr. C. M. Blanchard for another 1,000 light machine. At the present time it has in use 2,112 lamps.

The LaRoche Electric Works has been incorporated with a capital of $100,000 for the manufacture of dynamos, motors and general electrical machinery. The company has leased the entire building at 116 and 118 North Sixth St., Philadelphia, which has been remodelled. On the first floor are machine shop, engine and boiler rooms, showroom and well-appointed offices. The other floors are divided to suit the different departments which are necessary to their business. The La Roche company will make dynamos with a capacity of from 1 to 1,000 lights, and motors from ⅛ to five h. p. The company already has orders amounting to over $8,000 for isolated and central station plants. The officers of the company are as follows: president, G. Harry Davis; secretary J. F. Webb; treasurer, M. L. Finckle; and general manager, F. A. La-Roche.

The Burton Electric Company.—The annual meeting of the stockholders of the Burton Electric Company was held in Richmond, Va., on March 25, when W. R. Mason, of the Electric Merchandise Company, of Chicago, was elected president; W. J. Johnson, president Citizens' Bank, Richmond, vice-president; C. E. Wings, treasurer; A. Pizzini, secretary, and W. Leigh Burton, superintendent. Reports of officers showed the company to be in a prosperous condition. Superintendent Burton reported a large stock of electric heaters on hand, which had been paid for from part sales, and from recent testimonials of the satisfaction the heaters are giving in various parts of the country he anticipated large sales in the future. President Mason will be a valuable acquisition to the Burton Company, as his conection with a large electrical supply house places him in a peculiarly favorable position for bringing the Burton electric heater to the attention of electric railways.

The Wightman Electric Manufacturing Company, of Scranton, Pa., has elected Mr. J. R. McKee president of the company, and the concern, which is strongly backed by the Thomson-Houston Company, proposes to engage extensively in the manufacture of electric mining apparatus. The Wightman Company is at present engaged in the manufacture of electric street-car supplies at its Scranton establishment. Mr. McKee enters the Wightman Company as one of the representatives of the Thomson-Houston interests, the other representatives of the same interest being H. M. Byllesby, formerly of the Westinghouse Electric and Manufacturing Company, O. T. Crosby, and Winthrop Coffin. Messrs. Lathrop R. Bacon and J. B. Newcombe, of New York, and the Hon. Alfred Hand and Col. George Sanderson, of Scranton, withdrew recently from the directory. The other officers of the Wightman Company are: Merle J. Wightman, vice-president and electrician, and Herman Bergholtz, general manager and consulting engineer, and Horace E. Hand, secretary and treasurer.

Consolidation.—The Accumulator Company and the Electro-Dynamic Company, of Philadelphia (the latter company making the motors, gearing, switches and other apparatus, except accumulators embraced in the Edco system), have found it necessary to consolidate in Philadelphia their general offices, so that the officers and heads of departments of both companies shall be in constant communication with each other. New and commodious offices have been secured, fronting on 224-6 Chestnut street, Philadelphia, and extending back to Carter street, upon which the six-story factory of the Electro-Dynamic Company is located. These offices will be fitted up so as to accommodate the executive officers, the superintendent and the technical departments of both companies, at the same time enabling the factory facilities to be increased to the extent now covered by the Electro-Dynamic Company's offices. Mr. D. H. Bates, vice-president and general manager of the two companies, has resigned these positions, to date from May 1, in order to take a general selling agency for street car equipments upon the Edco system, with headquarters in New York City, in the same offices which the two companies named have occupied for the past five years. Messrs. Truex and Vail, also located at 44 Broadway, New York City, are the general selling agents for accumulators and Edco apparatus, for other than street car work, in New York and New Jersey.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, April 13, 1891.

Mr. J. R. Burdick, of the H. W. Johns Manufacturing Company, 87 Maiden Lane, New York, has returned to this city after a successful western trip.

The Newark (N. J.) Postal Cable Company was burned out last week by a most disastrous fire. The Western Union Company's building was also damaged.

Brooklyn Institute Lecture.—Mr. Edward H. Lyon will deliver a lecture on April 1 at the Y. M. C. A. Building, entitled "The Theory and Construction of the Telephone."

Lights in the Tunnel.—The trial of the incandescent lights in the Fourth Avenue tunnel is still going on, and it is expected that some final arrangement will soon be reached.

Mr. F. W. Baugher, of the Charles Munson Belting Company, Chicago, has temporarily moved his headquarters from Indianapolis to New York. Mr. Baugher's many friends will be glad to welcome him, and trust he may be induced to permanently reside in Gotham.

American Institute of Electrical Engineers.—The fifty-sixth meeting of the institute will be held on Tuesday evening, April 21, at 8 o'clock, at its rooms, No. 12 West Thirty-first street, near Fifth avenue. A paper will be read by Mr. Alexander S. Brown, of Boonton, N. J., entitled "The Electrical Extraction of Aluminium." The paper will be illustrated with electric-lantern slides. Members who are especially interested in the subject may be supplied with advance copies upon application to the secretary. A paper will also be read by Mr. N. D. C. Hodges, editor of *Science*, on a "New Theory and Practice of Protection Against Lighting. The council will meet in the secretary's office at 5 P. M. The annual and general meetings of the institute will be held in this city May 19, 20 and 21. Full particulars of these meetings will be given later. L. H. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
BOSTON, April 11, 1891.

Mr. Pratt, the well-known treasurer of the Jarvis Engineering Company, has returned from an extended trip to the south and west.

The T. M. Foote Regulator Company has opened an office in the new Exchange building, and will hereafter do its own manufacturing at the new factory.

Large Order for Knowles Belting.—One of the largest recent contracts for leather belting was recently closed by C. S. Knowles & Co., with the Bennett Manufacturing Company, of New Bedford, Mass., being no less than 24,033 feet of various widths and thickness.

Dr. Mason, of the Simplex Electrical Company, who has been sick for nearly three weeks and threatened with pneumonia, has started for a trip to Jamaica, intending to be gone some time. His many friends will wish him a pleasant voyage and an early return, completely restored to health.

Mr. C. Fred Hutchinson, owing to the constantly increasing press of business in connection with the New England Printing Telegraph Company, has sold his interest and severed his connection with the E. E. S. & C. Company, and will hereafter devote his entire attention to the former company.

Municipal Lighting.—The Committee on Manufactures of the Massachusetts Legislature has reported "no legislation necessary" on the orders and petitions relating to the municipal ownership of gas and electric plants. A minority report, however, has been made, and it is probable that the matter will be made a party measure in the State Senate.

The Essex Road Not Sold.—The statement that Mr. Norcross, of Boston, had purchased the Essex Electric Street Railway is denied by the directors, although it is well known that negotiations are pending for the same. C. A. B.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, April 11, 1891.

Prof. John E. Davies, of Madison, Wis., was in Chicago for a brief visit last week.

A new Chicago electric railway company has petitioned the council for franchises.

The Citizens' Electric Light Company has secured a valuable franchise from the City Council.

The Englewood Electric Light Company, of Englewood, Ill., has installed a large feed-water heater of the well-known Baragwanath make.

The Pueblo Supply and Construction Company, of Pueblo, Colo., has installed a United States dynamo of 100 lights capacity in the iceworks of that city.

The Sperry Mining Machine Company has lately placed on the market a line of switches for arc and incandescent work which are exceedingly neat, simple and durable.

The Pettingell-Andrews Company will hereafter be represented in the West by George Cutter, who will carry a stock of that company's "K. W." cut-outs and rosettes at Chicago.

The New Era Electric Storage Company has been meeting with excellent success in the introduction of its new storage battery. Several innovations are promised in the near future.

The annual election of officers of the Chicago Electric Club takes place on Thursday, April 16. Considerable interest is taken in this event, in view of the fact that two strong opposing tickets are in the field.

Electric Railway to Blue Island.—An electric railway is to be built from some undetermined point in the business district of Chicago, southward to Blue Island, a suburb 16 miles distant. The road will be double track throughout.

The Pumpelly Company to Sell Out.—The machinery and all other property and rights of the Pumpelly Storage Battery and Electric Motor Company will be sold at public auction in Chicago, April 30, 1891, at 205, 207 South Canal street.

Lamp Factory for Seattle, Wash.—Mr. A. Smith, of the Plattsmouth Electric Lamp Company, of Plattsmouth, Neb., has been in Seattle, to make arrangements to establish a factory there, with a capacity of 300 incandescent lamps per day.

Prof. Arthur T. Woods, Professor of Mechanical Engineering of the University of Illinois, at Champaign, favored the ELECTRICAL WORLD with a short call last week. The University will add a full and complete course of electrical engineering next September. H. C. E.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
13 CITY TRUST BUILDING, PHILADELPHIA, April 11, 1891.

Camden, N. J.—The Camden electric railway was again put in operation last week.

Baltimore, Md.—The Eutaw House is now illuminated with 250 incandescent lights. The plant was installed by the Wenstrom Company.

Mr. S. F. Taylor, representing Messrs. Patterson, Gottfried and Hunter, of New York City, was in Philadelphia on business last week.

Mr. C. M. Blanchard is acting as general agent for the Germania Electric Company, manufacturer of the Schaefer incandescent lamp.

Mr. J. W. Parker has contracted to furnish the Home Electric Light Company, of Tyrone, Pa., with a 150 h. p. Ball engine and a 250 h. p. boiler.

Mr. W. H. McKinlock, President of the Central Electric Company, is a victim of the "grippe," but expects to be out and around as usual in a few days.

Messrs. Vallee Bros. & Co. have taken the agency for the Diehl electric fan and motor. This enterprising firm is making quite extensive improvements both in its store and offices.

Pottsville, Pa.—The Schuylkill Electric Railway Company has ordered four 50,000-watt dynamos from the Short Electric Railway Company, of Cleveland, O., through its Philadelphia agent, Mr. E. W. Tisdall.

The Lockhaven Electric Company, whose plant was recently installed by Mr. C. M. Blanchard, of Philadelphia, has contracted with Mr. Blanchard for another 1,000-light machine of the National type. This company already has 1,350 incandescent lamps in actual use.

Mr. W. K. Westbrook reports the following sales this week from the isolated department of the Thomson-Houston Electric Light Company: One 300-light plant for Wm. R. Warner & Co., wholesale druggists; 155-light plant for Martin, Fuller & Co., and a small incandescent plant for Lehman & Bolden, the Arch street publishers.

Messrs. M. R. Muckle, Jr., & Co. have sold the Bristol Electric Light and Power Company a 750-light dynamo and exciter for the proposed increase in that station. It is evident that the management of the Bristol company has the full confidence of the stockholders, which is well deserved, since the paying of a dividend and the large amount of construction done has not exhausted the surplus.

The Quaker City Electric Company has found it necessary to seek more commodious quarters for the manufacture of its well-known dynamos and motors. The company has leased the three story brick building at 940 North Ninth street, of which it will occupy four floors, 21 × 100 feet each. The building is a substantial one, well lighted on three sides and located on the Pennsylvania & Reading Railroad.

Mr. W. A. Stadelman, of the Equitable Engineering and Construction Company in the Drexel building at Philadelphia, has just closed a contract with the Richmond and Manchester Railway Company, of Richmond, Va., for a small extension of that road to accommodate the increase in travel, which has made it necessary for the Richmond and Manchester to order five additional cars. The "Rae" motor will be used and two cars are expected to be in operation by next week.

The Equitable Engineering and Construction Company, which has probably done more electrical traveling crane work than any other concern in existence, is now doing the electrical work on several large Sellers' cranes which are under con-

struction at the shops of Wm. Sellers & Co., Philadelphia. One crane for the Schenectady Locomotive Works will have a 35-h. p. motor and the crane for Wm. Sellers & Co.'s new erecting shops will have a 40-h. p. motor. This latter crane will lift and carry 50 tons.

A New Firm of Electrical Engineers.—The firm of Clay & Pepper, of 1218-20 Filbert street, Philadelphia, has been reorganized, and will hereafter be known as Clay, Pepper & Register. The new member of the firm, Mr. Register, is a graduate of Cornell University, and has, since his graduation, been connected with the Thomson-Houston Electric Company, doing considerable work in the railway and other departments of that concern. His connection with the new firm, owing to his wide range of knowledge of electrical construction work, will be of considerable advantage. The firm of Clay & Pepper has carried on business in Philadelphia for nearly two years, and the new firm will continue the work of construction and installation of various kinds.

The Bala and Merion Electric Company, just incorporated for supplying electric light to the residents of Overbrook, Merion, Bala and vicinity, was organized largely through the efforts of Mr. W. A. Stadleman, of the Equitable Engineering and Construction Company, of Philadelphia, and who resides at Bala, Pa. The company, which is a very strong and influential one, will build a fine station at once, which will be equipped with the latest improved machinery, and will be a model in every way. The officers of the company are as follows: president, Mr. Cyrus Chambers, of Chambers Bros. & Co.; vice-president, Mr. Chas. Hartshorne, who is vice-president of the Lehigh Valley Railroad; secretary, Mr. John S. Guhard, of Overbrook; treasurer, Mr. Jas. M. Rhodes, of the Merchants' Trust Company, of Philadelphia.

The Williams Automatic Engines.—A party of engineers at Philadelphia, Pa., last week made a brake test of a Williams automatic engine to find the variation of speed under change of load, and variation under change of steam pressure. The engine tested was a vertical 5 × 16 inch, run at 435 revolutions per minute, with a boiler pressure of 60 pounds. With brake lifted off and engine running free the speed was 438 revolutions. The brake being put on and load applied, the speed was 435 revolutions. Cards were taken, and at one time steam followed nearly half stroke; load was then thrown off and the steam allowed to fall to 40 pounds, with change of speed. Then the load was put on, steam run up and then allowed to fall to 35 pounds before any change of speed was noticed. At no time during all the test was speed lower than 435 or higher than 438 revolutions. The Shaeffer and Budenburg tachometer was used for computing the power from cards. The highest was nearly 10 h. p., and the friction card showed less than seven-tenths of one horse-power. The brake power figured exactly the difference between the two. W. F. H.

SOUTHERN NOTES.

NORFOLK, Va., April 11, 1891.

The Bristol (Tenn.) Electric Railway is nearing completion, and will soon be in operation.

Roanoke, Va.—G. L. Colgate, it is stated, will begin to erect a $100,000 electric light and power plant.

Bluefield, Va.—Mr. Walter Graham and others have been awarded a contract to erect an electric light plant.

The Huntsville (Ala.) Electric Company is preparing to put an incandescent equipment into its electric light plant.

Brenham, Tex.—The city council is debating upon the question of establishing an electric light plant, and desires estimates for the same.

Ennis, Tex.—A contract has been awarded to the Dallas Construction Company, of Dallas, Tex., to erect an electric light plant in Ennis.

Macon, Ga.—An electric street railway is to be built to Belieview a suburb of Macon, by the American Loan and Investment Company.

Madison, Ga.—A contract is reported to have been awarded for the erection of an electric light plant recently reported as in contemplation.

Uniontown, Ala.—The city council has issued $25,000 of bonds for the establishment of an electric light plant and a water-works system.

The Salem (Va.) Electric Company, with $100,000 capital stock, has been formed for the purpose of establishing an electric light and power plant.

Raleigh, N. C.—Work has commenced on the new telegraph line from Raleigh to Hamlet, and is being constructed under the supervision of H. D. Hudgins.

The Brownwood Improvement Company, with a capital stock of $100,000, has been organized by E. B. Burlett and others, to erect an electric light plant.

Clifton Forge, Va.—Orders have been placed for two boilers of 70 h. p. and a 133-h. p. engine for the electric light plant of the Clifton Forge Electric Light Company.

Rome, Ga.—The Rome Gas Light Company contemplates the addition of new machinery to its electric light and gas plant, which will largely increase the capacity of same.

Buena Vista, Va.—New machinery has been ordered by the Buena Vista Electric Light Company, which, when placed in position, will double the capacity of that plant.

Newberry, S. C.—The City Council has had estimates furnished for the erection of an electric light plant to cost $15,000, and the question is now being considered for final action.

McMinnville, Tenn.—An election will be held shortly to vote upon the proposition to issue $20,000 of bonds for the establishment of an electric light plant and the construction of water-works.

Tullahoma, Tenn.—The electric light plant of Bolen and Gregg has been leased to W. H. McLemore, who will continue to operate the plant and will shortly add the incandescent system.

Shendun, Va.—The contract has been awarded for the building to be occupied as a power plant by the Electric Light and Power Company, of Shendun. The building will be of stone 45×35 feet with a slate roof.

Atlanta, Ga.—The new electric line to McPherson's Barracks will be in running order by the first of May. The power plant has been built, and is ready for work. Several electric cars have already been received.

Norfolk, Va.—The Signal Service telegraph wires have had quite a rough time of it during the recent stormy weather along this portion of the Atlantic seaboard. The service, however, is now working well again.

Louisville, Ky.—The Gooch Electric Light Company, recently incorporated, has amended its charter, changing its name to the Citizen's Electric Light and Power Company, and increased its capital stock from $100,000 to $300,000.

Washington, D. C.—The Tennalleytown Electric Railroad Company, during the recent stormy weather, was enabled to run its cars on time by means of the addition of extra trolleys on top and several small brooms in front of each car.

Big Stone Gap, Va.—The electric lights are utilized in a novel way in this town. The place as laid off is two miles wide and five miles long, and all this space is lit up by electric lights, and in the woods there the people hunt the 'possums and coons, not by the light of the moon or pine torches, but by the light of the electric lamps.

The Hendersonville Telegraph and Telephone Company, of Asheville, N. C., has been organized under a legislative charter, with C. A. Wilson as president. This company has commenced the construction of telephone lines from Hendersonville, N. C., to Brevard, a distance of 20 miles. This line is to be completed by May 1. The same company is looking into the cost of an electric railroad between Brevard and Asheville, a distance of about 32 miles.

The Greenville (S. C.) Gas, Electric Light and Power Company has been organized, with a capital stock of $50,000. This company has purchased the electric light and gas plant formerly owned by Asbury & Son, and the electric plant will be considerably enlarged, a complete duplicate set of machinery and generators added at once, including a 150 h. p. Corliss engine and boilers. The officers of the company are Colonel J. L. Orr, president; R. L. Asbury, vice-president; J. W. Cagel, G. G. Welt, F. W. Poe, J. H. Maxwell and N. C. Poe, directors. The gas and electric light works were turned over to the new company on April 1.

Memphis, Tenn.—The work of changing the street railway system of Memphis to an electric system has commenced. Six companies are bidding for the contract. The railway company has purchased a lot 175 × 290 feet, upon which site a power-house will be erected. This plant will have 1,500 h. p., fully 500 h. p. more than will be now needed. Work will begin on the building at once, and until the plant is completed the Memphis Light and Power Company will furnish power to run the cars. Orders for everything necessary for the equipment of the line in first-class style have been placed, with the exception of the contract for the electrical work. V. N. B.

WASHINGTON, D. C., April 11, 1891.

Lynchburg, Va., has adopted the Edison system of electric traction and has ordered eight cars for its three miles of double track road.

The Old Point and Hampton Railroad Company has ordered two more cars from the Brill company, of Philadelphia, and expects to have its road running by the 1st of May.

Petersburg, Va.—The Venerable Tobacco Company has recently installed a 350-light Edison plant. This sale, as also quite a number of others throughout this territory, belongs to Mr. Geo. Silsby, the efficient agent of the Edison company in this city.

The Metropolitan Railroad Company, of Washington, D. C., has received permission to erect its new power house, in which, under the superintendence of Mr. Mailloux, the company will erect its own motors, storage cells and cars for the entire road.

Washington, has been alive to the advantages of electric lighting, and the numerous recent installations make the capital one of the leading cities in the use of electric illumination. Seventh street, from the river to the city boundary line, is now ablaze with electric lights, and Fourteenth street is lighted from Pennsylvania avenue to the city limits. There are now about 400 arc lamps in the city paying 50 cents per night, and burning all night every night in the year.

The new iron steamers of the Potomac Steamboat Company have arrived from Wilmington, Del., and are in commission. They are each fitted throughout with incandescent lights, and have large search lights on their bows. Their arrival has put new life into the rival boats, and already the "Lady of the Lake," the "Sam J. Pentz" and the "Charles McCallister" have electric lighting installations. Several other boats have ordered plants, and by the advent of the summer excursion season the beautiful Potomac will beam with myriads of electric lights.

Isolated Plants.—Quite a large number of isolated plants have been installed and contracted for recently, among them being: Woodward & Lathrop's immense dry goods store plant, with 1,600 Mather lamps; the Shoreham Hotel, with 2,000 United States lamps the Normandie Hotel, with 600 lamps of the National Company; the State, War, and Navy Department buildings, with 3,000 Edison lights; the Washington Loan and Trust Company, with 1,200 lights of the Thomson-Houston Company; the Washington Market Company, with 600 incandescent lights and 100 arc lights of the Easton system. The second large building in this city to use the tubing of the Interior Conduit and Insulation Company is now being wired. The building is the property of Capt. Geo. E. Lemon, of pension fame, and will be used by him as a printing office for the *National Republican*. An isolated plant is contemplated, but not as yet contracted for. The file rooms of the Treasury Department are being wired for incandescent lights, gas being altogether too dangerous, and at the same time being injurious to the files.

Answers to Correspondents.

Questions to be answered in this column must be of general electrical interest, and must be accompanied by real name and address as a guarantee of good faith. No notice will be taken of questions regarding apparatus unless enough details are given to permit a definite answer, and no dynamo or motor designing will be done.

Definition of "Electrical Engineer."—By answering the following questions you will greatly oblige a reader: (1). What is understood by the term "Electrical Engineer?" To become an electrical engineer must one pass through a course of electrical engineering? (2). What causes a spark to jump from the commutator of a direct current dynamo to the brass washer which holds the segments together? Would a static charge from a belt do it? (3). What arrangements should be made for carrying off static discharges from dynamo belts? J. M. O.

(1). The definition of "engineer" is given in Webster's dictionary as follows: "One skilled in mathematics and mechanics, and who superintends works for military or civil objects," and an electrical engineer would be one who is skilled in mathematics, electrical theory and practice, and mechanics. Sir William Thomson says that an electrical engineer should be "one-tenth electrical and nine-tenths mechanical engineer," but opinions vary. However, one who has knowledge of mechanical and electrical technology, and who has had practice in electrical work, is an electrical engineer. It is necessary to go through a course of study in electrical engineering to become a thorough "E. E.," and it is rather difficult to acquire the necessary mathematical knowledge otherwise than by taking a college course. (2). Except in the case of dynamos generating extremely high pressures, the spark jumping is always due to a static effect. If the machine be separated from the earth or stone foundation by dry wood, it can happen that a charge from the belt will jump from the metal of the dynamo to the armature wire to get to earth by means of the line wires. Sparking can be caused between the commutator and the shaft by a charge from lightning flowing to earth by means of the metal of the dynamo, which may have connection with the earth. (3). Arrange a saw-toothed metal "comb" in close proximity to the belt near to the dynamo pulley and run a wire from this metal "comb" to the steam or water pipes. File a bright spot on the pipe and solder the wire thereto.

Ratio of Candle-Power Increase to Rise of Pressure.—Will you kindly answer the following questions: (1). I have some 117-volt nominal 16 c. p. lamps in circuit at 123 volts pressure, and as a result of the abnormal voltage the luminosity is above 16 c. p. What is the proportionate increase in candle-power to the increase in pressure? (2). How is it that no current traverses the "neutral" wire in the Edison three-wire system when the resistances in the side wire circuits are equal? W. A. G.

(1). It is impossible to give any rule which will apply to all cases, but the formula expressing the ratio between the increase in pressure and the consequent rise in luminosity is approximately as follows:

$$\frac{C P^1}{C P} = \left(\frac{E^1}{E}\right)^5$$

for lamps of about 110 volts normal pressure, and, assuming the above formula to hold good for the lamps in question, the equation

$$\frac{x}{16} = \left(\frac{123}{117}\right)^5$$

will give us about 24 c. p. for the value of x, or the candle power of your nominal 117-volt lamp at a pressure of 123 volts. You must not forget that the *life* of the lamps will be decreased in the same proportion. (2). The "neutral" wire, which lies between the two principal wires is *negative* in relation to the positive main wire, and *positive* in relation to the negative main wire. Suppose, now, 10 lamps are connected between the positive main wire and the "neutral" or centre wire—a current of, say, five ampères will flow from the station along the positive main wire, through the lamps, and then through the "neutral" wire from the lamps *to the station*. Now connect 10 lamps between the negative main wire and the centre wire; the tendency (since the "neutral" wire is positive in relation to the negative main wire) is for a current of 5 ampères to flow through the "neutral" wire *from the station*, through the lamps, and back to the plant through the negative main wire. Thus, we can imagine, there exists two opposite and equal tendencies for current to flow in the centre or "neutral" wire, and the result must be nil in the latter; but 5 ampères will now be flowing in the main wires. If now the balance of the sides is destroyed by the addition of, say, 10 lamps to one of the sides, then a current of 5 ampères will flow in the "neutral" wire, and the direction of such current flow will depend entirely upon which side of the centre wire the extra lights are added.

News of the Week.

THE TELEGRAPH.

Canadian Order of Railway Telegraphers.—A meeting was held in Toronto, Canada, last week, for the purpose of organizing Central Division No. 123, Toronto Order of Railway Telegraphers. A large number of operators from various parts of the Dominion were present, and, judging from the ardor displayed, this bids fair to become one of the most flourishing divisions of the order, which numbers about 10,000 members, and is rapidly increasing. After organization, election of officers and general business, two delegates were appointed to attend the annual grand convention, to be held at St. Louis, Mo., in June next.

THE TELEPHONE.

Albany (N. Y.) Telephone Exchange Burned.—A disastrous fire occurred last week at the central office of the Albany telephone building, and the two upper stories were badly damaged, causing a loss of $10,000. A great delay in the local telephone service will result.

THE ELECTRIC LIGHT.

Kenosha, Wis.—A contract has been signed for an electric light plant for the above town.

Oshkosh, Wis.—The electric light plant has added a new 1,500-light dynamo to its installation.

Rome, Ga.—The Rome Gaslight Company will soon increase the capacity of its electric light plant.

Aiken, S. C.—Mr. J. G. Gardner is to erect an electric light plant and is receiving bids for alternating-current machinery.

The Sterling (Ill.) Electric Light Company has closed a contract with the Thomson-Houston Electric Light Company for a 60-light arc plant.

Wheeling, W. Va., is calling for bids for the erection and installation of a 400-arc light plant. All proposals must be in before noon on April 23, 1891.

Maywood, Ill., has one of the most successful small plants in the country, and the number of customers has increased very rapidly during the past few months. The village of River Forest is to be lighted from the above station.

Duquoin, Ill.—At a regular meeting of the City Council last week a franchise was granted the Henry Willis Electric Light Company to erect and maintain a plant in that city. The work of erecting the plant will be commenced at once.

Terre Haute, Ind.—The Fort Wayne Electric Company has been at work for several weeks past putting in a large isolated electric light plant at the Terre Haute Brewing Company's works. There will be about 200 incandescent lights.

Roseburg, Ore.—Mr. L. L. Hurd, of Corvallis, Ore., has closed a contract with the city of Roseburg to erect a municipal electric light plant. The capacity of the plant is to be 20 arc lamps of 2,000 c. p. each, supplied by a Thomson-Houston machine.

Clyde, N. Y.—At a meeting of the Board of Trustees a contract was made with the electric light company for lighting the streets the ensuing year, the company furnishing 33 lights for 26 nights in a month at $60 each, to be lighted at sundown and extinguished at 1 o'clock A. M.

Waukesha, Wis.—The village trustees last week awarded a contract to the Waukesha Electric Light Company for lighting the

streets with electricity for five years. The business part of the town will be supplied with 16 arc lights, and the resident portion with 73 incandescent lights.

Mt. Carmel, Ill.—At a meeting of the City Council held last week it was decided to erect 30 2,000 c. p. arc lights, in accordance with the provisions of the contract recently made. The cost of the lights will be $1,800 per year, to burn every night and all night. The plant will also be arranged to furnish commercial incandescent lights.

Asbury Park, N. J.—The commissioners of this place have determined to give the visitors plenty of light this summer. They have just entered into a contract with the local electric light company to furnish for the beach and streets nearly double the number of lamps used last summer, and the lights are to burn all night during June, July, August, and September.

Greenville, S. C.—A stock company has been organized here with Col. James L. Orr president, and a capital stock of $55,000. They have bought the electric light and gas plants formerly owned by Asbury & Son, and will operate them together under the name of the Greenville Gas, Electric Light and Power Company. The electric plant will be removed to the side of the present gasworks, and a complete duplicate set of machinery and generators added at once, including a 150 h. p. Corliss engine and boilers.

To Enhance the Beauty of the Statue of Liberty.—Maj. D. P. Heap, Corps of Engineers U. S. A., stationed at the Lighthouse Depot, Tompkinsville, Staten Island, has a plan for the more perfect illumination of the Bartholdi Statue of Liberty, which, if adopted by the Lighthouse Board, will make the colossal statue a more imposing object, viewed at night in New York's harbor. At present the statue on Bedloe's Island is not brought out with the distinctness and clear relief to be attained by adjusting an improved lighting system. Major Heap proposes to have the crown a diadem of colored lights, and to so arrange a search light in the torch as to cast downward upon the figure a very powerful light.

The Wilkinsburg (Pa.) Electric Company, which recently purchased the lights of the East End Electric Company east of the city line, is erecting a new plant in a more central location in its territory near Edgewood, the principal suburb, formerly supplied by the East End Electric Light Company. The power house is to be of brick, about 60 by 80 feet in size, and the foundation is about completed. The necessary machinery was included in the purchase from the East End company, and the new plant will have a capacity of from 8,000 to 10,000 lights, several thousand more than needed at the present time. It will be ready about May 1, and until that time the East End company is continually to supply the lamps bought from them. The old plant of the Wilkinsburg company, near Brushton station, has been sold to Mr. W. U. Brinker.

THE ELECTRIC RAILWAY.

Brownwood, Tex.—The Brownwood Improvement Company which has been headed by Mr. E. B. Goelet, will build eight miles of electrical railway.

Macon, Ga.—The American Loan and Investment Company is to build an electric street railway from Macon to Belleview, a suburb of the latter city.

The Jamestown (N. Y.) Street Railway Company is installing an overhead trolley plant, the Short Electric Railway Company's system being used. When completed the road will have 14 miles of track, laid with 48 pound Johnson and 52 pound girder rails. There will be 10 motor and 13 trail cars.

The Eckington and Soldiers' Home Railway Company, Washington, D. C., in addition to its contract for a full equipment of Edco storage battery cars for its G street and Fifth street branches, has recently ordered from the Electro Dynamic Company two 40 h. p. Edco slow speed dynamos with self-oiling bronze bearings and tempered copper commutators, work on which is being pushed forward as rapidly as possible. The factory of the company is being worked to its full capacity, including three nights' service each week.

The Allentown (Pa.) Passenger Railway Company has received its franchise giving it the right to change the horse car line into an electric line. The approval of the ordinance closes the sale of the road to a Boston syndicate that has been negotiating for it for a year, the last condition of the sale being the granting of the right to change it into an electric road. Work on the reconstruction of the line will begin at once. The double trolley system is to be used. The rebuilding of the line is to be pushed as speedily as possible, and contracts call for June 1 as the opening of the new line. Wires, poles, rails and other material are here and coming, and cars have been ordered. The length of the line, when in full operation, will be 25 miles.

Westchester County (N. Y.) Electric Road.—The Board of Trustees of Mount Vernon have granted a franchise to the Yonkers, Mount Vernon, Pelham and New Rochelle Electric Railroad Company to contruct, maintain and operate a street railroad, single track, upon the streets and avenues of the village. The object of the company is to completely build and equip an electric railway from the city of Yonkers, N. Y., at the Hudson River, through said city to and through Mount Vernon, N. Y., on the streets named, through the town of East Chester, to and through the town of Pelham, and to and through the village of New Rochelle, touching at the stations of the several villages and towns of the Hudson River Railroad, the New York and Northern Railroad, and the Mount Vernon and Pelhamville stations of the New Haven Railroad, and touching the Sound, Pelham Bay Park and Travers and Glen Island.

The Bristol Belt Line Railway Company and the Bristol Street Car Company have been bought out by Mr. A. H. Leftwich, of Spartanburg, S. C., and Mr. W. A. Stadelman, of Philadelphia, Pa., who have already begun the work of consolidating these roads and changing them to an electric railway under the name of the Bristol Belt Line Railway Company. Mr. S. L. Nicholson has been made superintendent of the road, and a large force of men are now at work setting the poles, laying track, etc. The road will be over eight miles long, and five cars will be put in use at once. Compound condensing engines and steel tubular boilers will be placed in a brick power house, which is now being built. A frame car house 50 × 80 feet is being erected. It is expected that the road will be in operation by the middle of June. The "Rae" system will be used. Two 40 h. p. equipments and three 30 h. p. equipments, and one 65,000 watt generator will make up the electrical outfit.

Proposed Electric Road from Boston to Lynn.—For some months past there has been under consideration, by individuals connected with the Belt Line Electric Railroad Company of Lynn, the Boston & Revere Electric Railroad Company in Boston and Revere, and large property owners and capitalists, a plan for extending Ocean avenue in Revere—which runs parallel with the line of the Boston, Revere Beach & Lynn Railroad to near the Point of Pines—along the shore, through the Point of Pines property to the Saugus River, bridging the river, and extending the avenue, 60 feet in width, into the business section of Lynn. This avenue would open up a most important and much-needed highway between the whole of the Revere and Winthrop shores, and the city of Boston on the one hand and the city of Lynn on the other; or, in a broader sense, between Suffolk and Essex counties; and then, by the co-operative action of the Lynn Belt Line Electric Railroad Corporation, the Boston & Revere Electric Railroad Corporation, and the strong and influential individuals and interests, to extend the tracks of the two corporations named until they meet and connect at the Saugus River, there would be secured a through line of electric transportation between Boston and Lynn. The proposition is to have a double-track line, the tracks to be placed on one side of the new avenue, so as to leave an unobstructed highway for teaming and carriage driving. By this plan a fine double-track electric railway line, connecting with the East Boston tracks of the great West End system, would be established between Boston, the Revere and Winthrop shores, the city of Lynn and the unequaled Lynn Forest Park, containing more than 1,200 acres of wild woods, dotted with lakes, the whole of which is accessible by fine driveways and avenues, which are penetrated by the lines of the belt railways.

LEGAL NOTES.

Municipal Ownership of Plants.—Concerning the case of H. L. Braden vs. The City of Crawfordsville (Ind.), in which a temporary injunction had been granted preventing the city from erecting an electric light plant, the court entered a modified decree holding that the city could put in a plant to do public lighting, but restraining it from purchasing a plant to be used for commercial lighting also. Therefore the City Council will meet and strike out that part of the resolution referring to commercial lighting before proceeding to build the new works.

Production of Documents in an Action for Infringement.—Complaint in an action for the infringement of a patent made admissions, on an application for another patent on which letters were never issued, which defendant contends greatly restricts the claim of the patent in suit. Complainant could not refuse obedience to a *subpœna duces tecum* to produce such application, and the correspondence with the patent office in regard thereto, on the ground that such documents, if produced, would be immaterial, as the court will not pass on that question until evidence is before it. The fact that the application for the unissued patent, and the letters to the patent office in regard thereto, are the result of consultations between complainant and his counsel, does not render them privileged as confidential communications, since they ceased to be confidential when complainant and his counsel parted with exclusive knowledge of their contents by sending them to the patent office. (Edison Electric Light Company v. United States Electric Lighting Company, Circuit Court of the United States, Southern District of New York, 44 Fed. Rep., 294.)

Infringement of Patent for Electric Arc Lamp.—The lamp manufactured under Letters Patent No. 219,208, granted to Charles F. Brush Sept. 2, 1879, for "an electric lamp," is a duplex lamp, organized to burn two or more pairs of carbons successively, and its distinguishing features are the arrangement of the feeding mechanism so that the carbons of the two pairs are dissimultaneously separated to form the arc, and after the arc is formed between two carbons one is fed toward the other as fast as it is consumed, and when this pair is fully consumed the electric current is automatically transferred to the other pair. This feeding mechanism is operated entirely by electricity. Brush showed in his specifications that the feeding could be done by a clutch mechanism, suggested that it might be done by clockwork, but expressly said that he did not limit himself to any specific mechanism for obtaining the desired results. The patent is infringed by a lamp having the same characteristics, and differing only in that the feeding mechanism is operated by clockwork, which, however, is brought into action and controlled by electricity: and it is immaterial that in the latter the carbons may be separated by hand, where it appears that if this is not done the machine will do it as in the Brush lamp. (Brush Electric Company v. Ft. Wayne Electric Company, Circuit Court of the United States, District of Indiana, 44 Federal Rep., 284.)

PERSONALS.

Mr. Edgar H. Farrar, Attorney for the Fort Wayne Electric Company, at New Orleans, La., is visiting the factories in Fort Wayne, Ind.

Mr. George W. Nelles has been appointed agent for the Royal Electric Dynamo and Motor Company, of Peoria, Ill., with headquarters at Kansas City, Mo.

Mr. Albon Platt Man, one of the oldest and best known members of the New York bar, and for some years connected with the Sawyer-Man Electric Company died last week at his home in New York City.

Mr. Richmond Smith, one of the old-timers in the telegraph service and one of the best known men of the fraternity, died at his home in Brooklyn last week of apoplexy. He was an assistant of Telegraph Superintendent Somerville in the Southwest in the civil war, and was selected to accompany General Sherman in the march to the sea. When the war closed he was made superintendent of the western lines of the United States Telegraph Company, and later became cashier of the Boston office of the Western Union. Of late years he was employed in the New York office of that company.

MISCELLANEOUS NOTES.

"The History of Electricity" is the subject of two articles which have recently appeared in the *New England Magazine*. They are from the pen of George H. Stockbridge, and cover the work of Franklin, Henry, Morse, Vail, Page and Farmer in the earlier years, and that of Field, Edison, Thomson, Weston, Sprague and Van Depeole in more recent times. These chapters of American electrical history are very interesting reading, and contain a great deal of information, which has been collected with considerable labor from various sources. These articles are the first of a series which will appear in the *New England Magazine* on electrical subjects.

A Book on Patents.—Mr. Levin H. Campbell, of Washington, D. C., assistant examiner in the United States Patent Office, has just issued a small pamphlet, of which he is the author, entitled "The Patent System of the United States: a History." Mr. Campbell has undertaken to give a brief and comprehensive history of the system so far as it relates to the granting of patents, and includes in his description an account of the office and all thing relating to the issue of patents. Inventors will derive from the reading of this book a higher ideal of the patent system as a whole, and will take a more intelligent interest in its preservation. It contains much information, which has been obtained after extended search covering both papers and books published by authority of Congress and private publications during the periods covered by the different chapters.

Industrial and Trade Notes.

George Cutter, of Chicago, has just received over six thousand of the incandescent lamps made by the Germania Electric Company, of Boston, with which to supply the Western trade.

The Okonite Company states that "while all New York City is suffering from the 'grippe,' it is in order to say that 'okonite' has the strongest grip noticed in electrical circles." Business, it is said, is good with the International Okonite Company.

Mr. A. Remhof, of 375-81 Kent avenue, Brooklyn, N. Y., successor to Charles Remhof, the well-known metal spinner, has recently produced some very beautiful spun brass light fixtures. Mr. Remhof's designs have an originality about them which will always keep his work in the front ranks.

The Manhattan Electrical Supply Company, of 36 Cortlandt street, is mailing to the trade a supplement to its regular catalogue that bears the novel heading "This is Our Drummer." In this pamphlet the company shows some of its latest novelties, including wood and iron box bells of excellent design.

Mr. Matthew J. Bogart, of 103 William street, New York City, with mills in Maine and Vermont, makes a specialty of turned push-button shells and ceiling rosettes for electrical works. The Bogart push-button shells are of most handsome and practical design, and are made of all varieties and kinds of woods.

The Triumph Compound Engine Company reports prospects for business as excellent. Orders are coming in rapidly, and its sales in March, 1891, were 50 per cent. higher than in the corresponding month last year. These engines are coming into prominent notice, many being shipped to foreign countries for electric light plants.

Mr. McCollum, who for eight years has been connected with the National Meter Company of New York, and well known in the electric business, has secured a position with Messrs. L. J. Wing & Co., of New York City, manufacturers of disc fans, high speed engines, electric motors, etc. Mr. McCollum will have charge of the installing of the gas engines of Messrs. Wing & Co.

Hanson, Van Winkle & Co., of Newark, N. J., have issued a catalogue of electroplating and polishing material and machinery, of which they are the manufacturers. Besides a full list of such apparatus the pamphlet contains much information of value to those in charge of electroplating works and to electrical men generally. It is supplemented by a partial list of users of the company's machines and material.

The Nashville (Tenn.) Electric Time and Advertising Company changed hands last week. Mr. L. W. Johnson, electrician, who has been in the electrical business over ten years, takes the management of the company. Mr. Johnson intends to put the lines and clocks in first-class shape at once, also to make arrangements with the Western Union Telegraph Company to have all clocks synchronized by telegraph time from the Washington observatory every day.

The Tropical American Telephone Company, of Boston, Mass., and New York City, is receiving some very flattering letters commending its "Williams" standard switchboard and long-distance Berliner telephone sets. Among the later letters are those from the manager of the Colonial Government telephone system in the West Indies; the treasurer of the Bermuda Telephone Company, Ltd.; the United States Consul at Cienfuegos for the fire department, and from the West Indian agent of the Massachusetts Electrical Engineering Company.

The Midland Electric Company, of Denver, Colo., has purchased the supply business of the River and Rail Electric Company, together with all outstanding accounts, and requests that all moneys due the latter company be paid to the Midland Company, and that future correspondence be addressed to the same concern. The River and Rail Company has turned over to the Midland Company its entire business except that relating to storage battery cars, storage batteries and motors manufactured under the patents of the River and Rail Electric Light Company, of West Virginia.

Messrs. Taylor & Son, of 39 Dey street, New York City, have recently improved their battery-cell depolarizing solution, and have reduced the price so that it will be within reach of all consumers. It is intended to revolve the lights on the lightships by a reliable motor. Messrs. Taylor & Son have just tested a Lugo motor for the Lighthouse Department and with one charge of their depolarizing solution powder in nine cells they ran the motor 76 hours and developed one-fifth h. p. constantly. These facts are interesting as showing the progress made in the use of chemical energy for producing the electric current.

A Substitute for Rubber Insulation.—A prominent manufacturer who had agreed to furnish the Pacific cable from California to China and the cable from Galveston to Guatemala is reported as saying that there is not enough rubber in sight to make the two cables. In view of this fact a cheaper insulation that will answer all purposes of rubber is very much needed. A compound is reported to have been perfected that is an excellent insulator, acid-proof, fire and water proof, and it is claimed that the action of the elements cannot disintegrate it. The cost of manufacture is very low. The full results of tests will soon be ready for publication.

A New Electric Cigar Lighter.—The Barr Manufacturing Company, of 17 and 19 Broadway, New York City, is introducing an electric cigar lighter which has many new features. The electrical energy is generated by chemical action. The construction is simple, and the lighter can be taken apart and put together very easily. In using it a button on the top is pressed and the lighter "does the rest," that is, it completes the circuit so that in applying the holder, which is saturated with alcohol, it immediately ignites, and as the olders are made of asbestos they meet with no deterioration. The material to charge the battery can be obtained at any drug store and will operate the lighter from 30 to 60 days, according to use.

Business Notices.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

The Montauk Electric Light Company, of Brooklyn, N. Y., has been incorporated with a capital stock of $50,000 to manufacture and transmit electricity for light, heat and power. The trustees are Alfred L. Hough, Wm. J. Stitt and Joseph Honig, all of New York.

Partner Wanted.—A gentleman about to sever his connection with a prominent electric light company, for whom he is acting in the capacity of agent, is desirous of entering into partnership with a first-class man having some capital and competent to take charge of office duties. He has a large number of central station and isolated plants in an advanced stage of development, and the outlook is very promising. For the right party this is a big inducement. Address "Edisonia," care of THE ELECTRICAL WORLD.

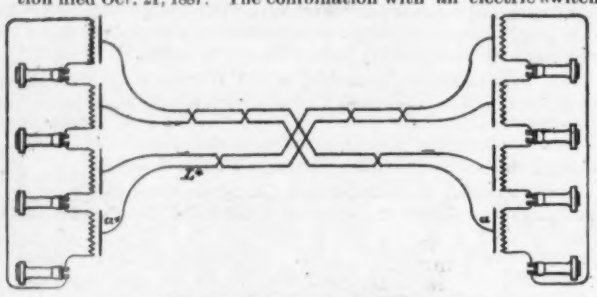
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. PATENTS ISSUED APRIL 7, 1891.

449,646. Circuit-Breaker for Incandescent Electric Light Systems; Friedrich Müller and James G. Greene, of Elizabeth, N. J. Application filed July 23, 1890. An electric lighting system comprising a circuit, having a number of incandescent lamps connected in multiple arc and a circuit-breaker having two breaking-points, one of which is controlled by an electro-magnet in a lamp circuit and the other by a manually operated circuit restoring device.

449,655. Telegraphy; Frank Anderson, of Peekskill, N. Y.; Annie L. Anderson, Gilbert H. Anderson and Homer Anderson, administrators of said Frank Anderson, deceased. Application filed May 31, 1890. A telegraphic transmitter having raised Morse or equivalent characters on a movable part, in combination with a pivoted transmitting arm located substantially at right angles to the direction of motion of the movable part and electrical connection, whereby the characters are accurately reproduced electrically.

449,660. Automatic Switch for Electric Motors; Wm. Baxter, Jr., of Baltimore county, assignor to the Baxter Electric Manufacturing and Motor Company, of Baltimore, Md. Application filed Oct. 21, 1887. The combination with an electric switch



No. 449,679.—MULTIPLEX TELEPHONY.

and connections adapted to close the electric circuit of a spring adapted to move the switch to its inoperative position, a tooth moved with the switch, a toggle straightened against such tooth, and an electromagnet affected by the circuit through the switch and operated to bend the toggle to unlock the switch lever.

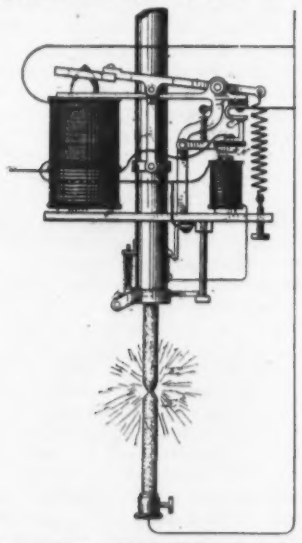
449,661. Electrical Hoisting Machine; Wm. Baxter, Jr., of Baltimore county, Assignor to the Baxter Electric Motor Company, of Baltimore, Md. Application filed March 2, 1888. The invention consists partly in the combination of a motor having only two magnet-cores with a drum and worm gearing upon a single bed, the whole forming a complete organized portable machine, and the bed forming the bridge or yoke of the two magnet cores; in an inclined arrangement for the armature shaft, so that the worm applied thereto may be immersed in oil in an inclined trough.

449,662. System of Operating Electric Elevators with Landing Switches Only; Wm. Baxter, Jr., of Baltimore county, Assignor to the Baxter Electric Motor Company, of Baltimore, Md. Application filed April 20, 1888. The combination with a suspended car moving in a hoistway, of hoisting mechanism operated by an electric motor, an electric circuit connected normally through the armature of the motor, a series of landings, and a series of landing switches located thereon and provided with contacts for controlling the course of the current in said circuit.

449,672. Train-Signals; Hugh J. Finn and John A. Garner of Kansas City, Mo. Application filed Nov. 14, 1890. A train signal consisting of an electrical conductor, a source of electricity, a circuit-breaker and an electric bell with a coupling having jaws pivoted together at their inner ends upon a pivot-pin arranged to slide in the sides of a casing, held in place at the bottom of the said casing by a suitable spring, and pressed together by a spring.

449,679. Multiplex Telephony; William W. Jacques, of Newton, Assignor to the American Bell Telephone Company, of Boston, Mass. Application filed Dec. 1, 1890. The invention consists in connecting up at each end of the circuits the three or more line wires with an equal number of Muirhead condensers and an equal number of telephone loops, each line wire making connection with the armature strip of a separate condenser and each loop making connection with the conducting strips of two condensers. The resistance and capacity of the condensers are such that the energy of a telephone current excited in one of the loops and passing into the two conducting strips directly connected therewith will be transferred to the armature strip of the said two condensers. (See illustration.)

449,685. Electrical Switchboard; John B. Lyon, of Brooklyn, N. Y. Application filed Nov. 20, 1890. The combination with



No. 449,715.—ELECTRIC ARC LAMP.

a multiple switchboard, of the wires which connect all the sockets in any given row of the switchboard united into a web or band. (See illustration.)

449,690. Non-Interference Electrical Signaling Apparatus; Abraham Newman, of Brooklyn, N. Y. Application filed Feb. 28, 1890. The combination of a shaft, a plate fastened to said shaft, a device whereby said plate may be locked against movement, a stop for limiting the movement of said shaft, a ratchet on said shaft, a pawl mounted on a wheel and capable of engagement with said ratchet, means for regulating the speed of travel of said last-mentioned wheel, another wheel mounted with said last mentioned wheel and capable of revolving with it and having electrical contact points, means for preventing said wheel having electrical contact points from revolving in more than one direction, and means for revolving the shaft in a direction opposite to that in which it is turned.

449,700. Electric Connector; Geo. K. Wheeler, of Chicago, Ill., Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed Nov. 26, 1890. The combination of a relatively large conductor, such as a railway rail, and a wire to be attached thereto, with a connector consisting of a spool or thimble having a solid driving head and split for a portion of its length to form springs jaws, which are adapted to clamp the wire when the spool is driven into an opening in the conductor.

449,709. Propelling Mechanism for Electric-Motor Cars; Sidney H. Short, of Cleveland, O., Assignor to the Short Electric Railway Company, of same place. Application filed Dec. 11, 1890. The combination, in an electric-motor car, of the armature of the motor axially mounted and directly connected with the car axle, with a hanger-frame pendulously suspended from the car axle, the field magnet frame independently supported upon the hanger-frame, and means for preventing the rotation of the latter with the car axle. (See illustration.)

449,715. Electric Arc Lamp; Elihu Thomson and Edwin Wilbur Rice, Jr., of Lynn, Mass. Application filed April 9, 1885. The invention consists in the combination of a movable guide-tube for the carbon, movable by or suspended from the feed-regulating or carbon-adjusting magnet of the lamp and serving to guide the carbon at its upper end, and a carbon lifting or separating and feed-releasing clamp or clutch carried or supported by said guide. (See illustration.)

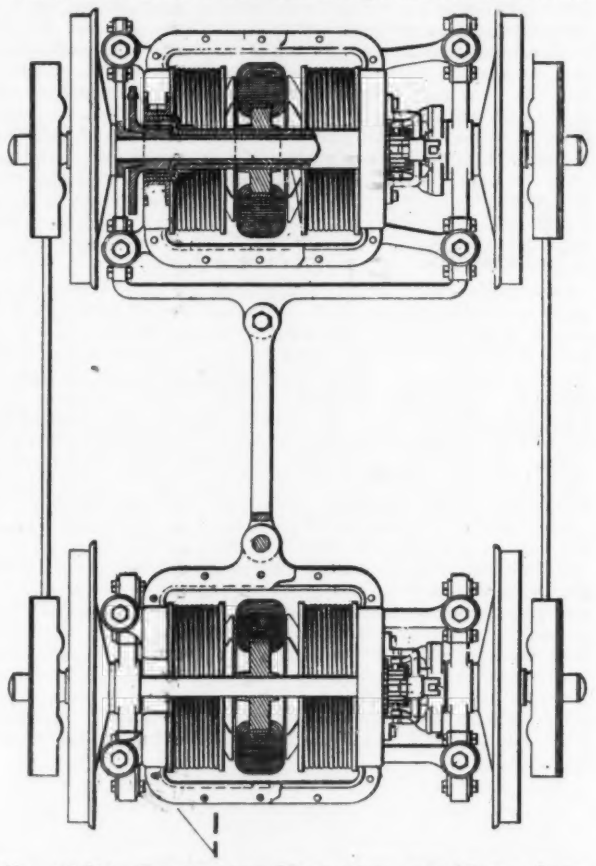
449,726. Process of and Apparatus for Separating Ores Magnetically; Clinton M. Ball, of Troy, N. Y., and Sheldon Norton, of Hokendauqua, Pa. Application filed June 30, 1890. The process of separating iron or its crushed ore from impurities and concentrating it, consisting in passing the ore and gangue through consecutive magnetic fields, and at the same time impressing upon it differing degrees of tangential inertia in the consecutive magnetic fields.

449,731. Automatic Electric Block System; Jos. A. Carlton and Henry L. Johnston, of Atlanta, Ga. Application filed Dec. 3, 1890. In an automatic electric block system a frame secured to the track, and a lever pivoted thereto, carrying a spring-brush, adapted to contact with the circuit-terminals set in said frame, said lever having an inclined top end for contact with a wheel of railway rolling stock.

449,752. Electric Motor Car; Harold P. Brown, of New York. Application filed May 26, 1890. The combination in an electric motor car, of an electric motor having a revolving shaft, a grooved driving pulley by which motion is communicated to said axle, a rope connection between said pulleys for communicating motion from the motor to the car, and a rope tightener pulley.

449,766. Ammeter or Voltmeter; Harold C. Shubert, of Chicago, Ill., Assignor of one-third to Warren B. Martindale, of Kenosha, Wis. Application filed Oct. 31, 1890. The invention consists in the combination with two opposed soft-iron plates inclosed within an encircling coil included in an electric circuit, one of which is fixed and the other secured to a spindle carrying an indicating pointer, of a coiled spring governing the spindle and a regulating lever controlling the spring for its adjustment, the spring operating when adjusted to produce a contact of the soft-iron plates, so that the repulsion of the plates when magnetized by a current in the coil may be measured by the tension of the spring to indicate the amount or force of said current.

449,767. Cut-Out; Alfred T. Tregurtha, of Everett, Assignor of one-half to Henry A. Clark, of Boston, Mass. Application filed Feb. 25, 1889. The combination, with a base having electric contacts thereon for connection with the main wires of the electric circuit and a lamp having its electric wires, each connected to an independent electric contact on said base, by which wires the lamp is suspended and supported, of a cap or cover having electric contacts on its inner side, each two connected by a separate fusible electric wire, and said electric contacts being arranged to engage with and to be connected to the electric contacts on said



No. 449,709.—PROPELLING MECHANISM FOR MOTOR CARS.

base to make electric connection therewith, and to secure and hold said cap or cover in position on the base.

449,774. Commutator for Electric Motors; Henry Duenner, of Boston, Mass., Assignor of one-half to Frederick Bleiler, of same place. The invention consists in mounting the brushes upon a spindle, which is movable longitudinally, and applying thereto crosshead slides and an adjusting screw so that by a single turn of the screw the brushes may be adjusted longitudinally.

449,792. Electric Railway; Edward M. Bentley, of New York. Application filed Jan. 30, 1888. The invention consists in providing a trolley adapted to ride upon the supply conductor, with a pulling wire or rope, having a shifting point or connection therewith, whereby the trolley can be pulled from one side or the other of the main conductor as may be desirable.

449,797. Electric Railway; Rudolph M. Hunter, of Philadelphia Pa., Assignor by mesne assignment to the Thomson-Houston Electric Company, of Boston, Mass. Application filed Dec. 15, 1888. The combination of a railway, a slotted conduit arranged to one side of the railway track and outside the rails thereof, a conductor arranged within the conduit, a traveling vehicle, an electric motor to propel the vehicle a laterally movable current-collecting device carried by the vehicle extending outside of its wheel-base and making a traveling connection with the conductor in the conduit and a flexible circuit arranged between the motor and the current-collecting devices whereby the collector may move laterally without interfering with the electric connection with the motor.

449,829. Auxiliary Fire Alarm and Extinguisher System; Eason L. Slocum, of Pawtucket, R. I. Application filed Jan. 4, 1889. The combination of a metal disc, A caliper-formed spring for holding the same, and an electrically connected and adjusted push-button.

449,832. Bell; Arthur F. Stanley, of New York. Application filed May 29, 1890. An electromagnetic hammer for electric bells, consisting of an armature, a stem, and a perforated hammer disc, stamped in one flat integral piece of iron or steel, in combination with a peen of other metal, attached thereto by the stem.

449,836. Method of Electric Welding; Elihu Thomson, of Swampscott, Mass., Assignor to the Thomson Electric Welding Company, of Maine. Application filed July 11, 1890. The method of electric welding by placing pieces in abutment, heating them by a current of electricity passing from one to the other, and then subjecting them to end pressure, consisting in expanding or upsetting the metal of the work either before or after the welding operation, and then employing the hammering, rolling, or other reducing operation used for restoring the character of the metal.

449,843. Electric Car Stopping Device; Geo. Webber Blanchard, of Waterville, Me., Assignor of one-half to Sophia G. Webber, of same place. Application filed Oct. 16, 1890. A locking device for the gears of an electric motor, in combination with a solenoid or magnet and electrical connections for holding said locking device normally out of engagement.

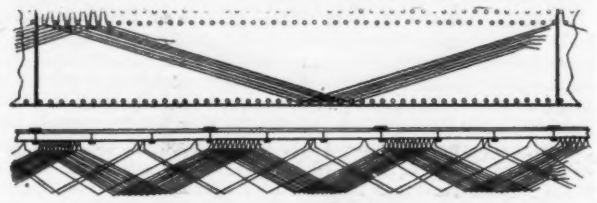
449,847. Electrical Dental Engine; Frank F. Eggers, of San Francisco, Cal. Application filed Dec. 10, 1890. The combination, with a dental bracket and a driving-shaft journaled within it, of an electric motor journaled within the bracket-frame and connected directly with the driving-shaft.

449,866. Automatic Bell-Ringer; William W. Slater, of Oakland, Cal. Application filed Jan. 6, 1891. This invention consists of a bell fixed to a suitable support having a swinging tongue or clapper and an air-actuated mechanism whereby the clapper is caused to swing, an electro-magnetic device whereby the valve is opened and closed, and a means for alternately making and breaking the circuit for this purpose.

449,886. Trolley Support for Electric Cars; Frank Robinson and Percy W. J. Lander, of Bangor, Me. Application filed Jan. 12, 1891. An automatic-operating trolley arm connector, consisting of a vertical tube, having projections at each end provided with means for attachment to the ordinary electric car standard, the upper projections having an arm extending therefrom, with its extremity adapted to be hinged to a trolley arm, a tension rod extending through said vertical tube, and having its lower end provided with means for connecting the tension spring, and the upper portion of said tension rod having a notch or small shoulder for the engagement of a confining catch, a catch adapted to engage the notch or shoulder to said catch, and extending in such a manner that certain movements of the trolley arm disengage said catch.

449,889. Electric Valve-Controller; George E. Turner, of Marion, Ohio. Application filed Aug. 12, 1890. The invention consists of a sliding valve and its stem, the latter provided with two lugs and a wheel having a zigzag rim located between the lugs, and an electro-magnetic apparatus for imparting a step-by-step movement to the wheel. (See illustration.)

449,890. Apparatus for Electroplating Small Articles; Frederic Wm. Zingsem, of New York. Application



No. 449,685.—ELECTRICAL SWITCHBOARD.

filed Oct. 17, 1890. An apparatus for electroplating small articles, which consists of a solution tank, a shaft supported in conductive bearings of said tank, a rotary reticulated drum of non-conductive material attached to the shaft, and a conducting wire connected to the shaft and extending spirally through the drum.

449,897. Telegraphy; Robert G. Brown, of Brooklyn, Assignor to the Standard Multiplex Telegraph Company, of New York. Application filed June 27, 1887. The combination, with the synchronous trailer and the segments connected in pairs, of a transmitting magnet and armature, a main battery connected through the armature to the first segment of the pair, a receiving pulley, and a connection to the second segment of such a pair, and a shunt and resistance around the receiving-relay.

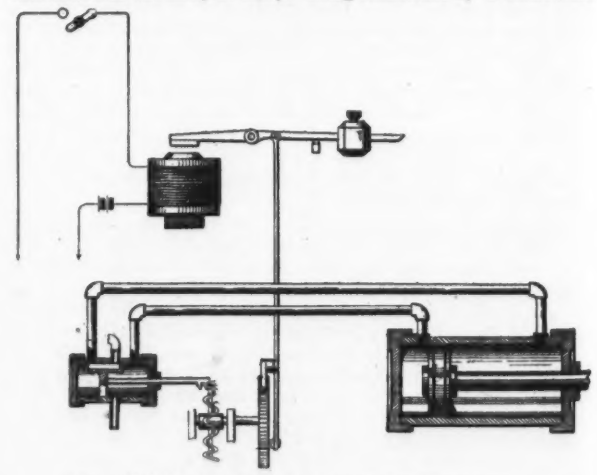
449,903. Lightning Arrester; James Watson Easton, of New York, Assignor to P. Minturn Smith, of Plainfield, N. J., and Wm. D. Perry, of Brooklyn, N. Y. Application filed Aug. 14, 1890. In a lightning arrester having a solenoid, a core and a plunger supporting said core, a swinging clamp pivoted below the solenoid and carrying an adjustable electrode and a fixed electrode adjacent thereto.

449,921. Electric Cut-Out; Alfred T. Tregurtha, of Everett, Assignor of one-half to Henry A. Clark, of Boston, Mass. Application filed April 17, 1890. The combination, with a base having a flange or rim, a chamber, a tranverse recess or groove in said flange or rim, and a cap or cover provided with an electric contact plate or arm, of an electric contact block fitting in said recess or groove, adapted to receive and hold an electric wire at its outer end, its inner end projecting over the chamber and adapted to engage with said plate or arm to make electric contact therewith and secure and hold the cap or cover on the base.

449,943. Insulator; Louis McCarthy, of Boston, Mass. Application filed Jan. 16, 1891. An insulator, comprising a bell or case adapted to hold a series of sheets of mica, a metallic supporting-piece placed therein, and a series of sheets of mica surrounding said piece and adapted to isulate the same from said bell or case.

449,990. Automatic Railway Signal; Calvin H. Wilhelm, of Mauch Chunk, Pa. Application filed Sept. 23, 1890. This invention consists of a lever arranged adjacent to the sides of a rail and adapted to be depressed by the tread of a wheel, a series of locking levers, latches, etc., adapted to be operated by the track lever to set and lock the signal, a plurality of electro-magnets each adapted to release its respective latch to operate upon the signal in a definite manner, and a single battery at each station for operating the magnets at the station.

450,000. Electric Lamp for Street Lighting; Hiram H. Carpenter, of Chicago, Ill. Application filed Feb. 19, 1891. The invention consists of a substantial case of considerable height and limited area in cross-section, which forms the main stem of the post, and which contains shelves or movable interior cases for the reception of a number of secondary battery bells and is closed by a door. The top of this case is surmounted by a bracket carrying the electric lamp holder or holders, the circuit between the batteries and the lamp or lamps being controlled by a clock time



No. 449,889.—ELECTRIC VALVE-CONTROLLER.

switch, the dial of which is mounted upon the exterior of the main stem of the post in position to be covered by the door thereof, which has in it a window or bull's eye, through which the dial is visible.

450,068. Electrical Lock; Heinrich Grefen, of Oberhausen, Germany. Application filed May 19, 1890. The combination of a locking bolt, a lever for withdrawing said locking bolt, a latch bolt controlling said lever and having a projecting spring, a detent for opposing the operation of said bolt upon the lever and means for controlling said detent.

450,074. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa., Assignor to the Thomson-Houston Electric Co., of Connecticut. Application filed May 29, 1889. The combination of a railway track, a series of posts or poles arranged along said track, a supply conductor and a working conductor connected in parallel and suspended upon the opposite sides or portions of said posts or poles at an elevation above the track and so that the working conductor adjacent to the track, a traveling car, an electric motor to propel the said car, a laterally movable collector moving with the car, and making a traveling contact with the suspended working conductor upon its under side, and a motor-circuit on the car for supplying current from the collector to the motor.

450,101. Cut-Out; Jacob S. Gibbs, of Hartford, Conn., Assignor to the Perkins Electric Switch Mfg. Co., of same place. Application filed Feb. 11, 1891. A cut-out, consisting of a base, bearing pole pieces, the inner ends of which project at an angle with the plane of the base, and a cap bearing conductors, the ends of which project at a similar angle with the ends of the pole pieces upon the base.

450,105. Carbon Electrode for Electric Batteries; Ernest Arthur Le Seur, of Ottawa, Canada. Assignor of one-half to Chas. N. Waite, of Newton, Mass. Application filed Oct. 14, 1890. An electrode for an electrolytic cell, consisting of a number of pieces of rough carbon cut to equal lengths and having rough uncut sides and a metallic backing, in which said carbon pieces are embedded at one end.